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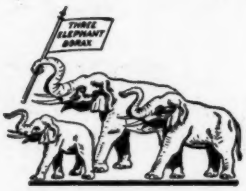

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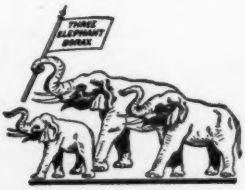

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Better Crops with PLANT FOOD

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R. H. STINCHFIELD, *Editor*

Editorial Office: 1155 16th Street, N. W., Washington, D. C.

VOLUME XXVII NUMBER 1

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THE OLD SWIMMING HOLE!

Better Crops with PLANT FOOD

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Looking Ahead to . . .

Our Renaissance

Jeff McDermid

WORLD-SHAKING events of first magnitude being under way at the year's beginning, I wedge my way into the anxious crowd of onlookers, recalling a passage of my youth which best seems to fit the present mood.

I was a country kid about ten years old and had never been a railroad passenger. I would lie awake and listen for the weird, shrill whistle of the old Pioneer Limited, coming ponderously down the sandy cut a half mile away. A flash of headlight gleam would cut across my bedroom ceiling, a roar of thunderous grinding would shake the joists, and it was gone.

Or again, I would trudge with my faithful hound dog, Muggsy, down the rutted road to the railway crossing, to sit in the shade of a locust tree and wait for Number Five to come ripsnorting down the track. Finally, in a halo of steam and murky smoke it flashed into view, gleaming metal vibrating in the summer sunshine, rows of windows disclosing fortunate travelers probably wondering what kind of Godforsaken land they had bungled into overnight; the engineer and fireman leaning from the cab door to wave grimy gloves at me and my canine companion.

Or, in late summer twilights I would perch on my cot in the loft room facing westward, with the setting sun throwing gorgeous tones across the western pathway of the roaring express bound for Minnesota and points beyond—far beyond, to the land of Custer, Buffalo Bill, and maybe Yosemite and the Golden Gate. To the last faint gleam and dying whistle I would bend eagerly after it, tracing its disappearance be-

yond the top of Bender's Hill, which was the last link connecting my small world with the realm of the Great Unknown, the other side of the sunset.

No, I did not hanker, like some of my boyhood chums to grow up into a brawny switchman or a car-walking brakeman in constant terror of life and limb for the sake of somebody's merchandise. I had no visions of becoming a conductor or a train dispatcher either, much as those professions seemed to mark their owners with rare distinction.

TO make a long story short, my dreams were always of being wafted away, carried endlessly on shining rails, peering continually on new and delightful scenery, seeing and knowing new places and new friends, and growing cosmopolitan and worldly-wise, replete with poise, and aglow with having seen and conquered that stretch of land beyond Bender's Hill.

Now to be quite honest about it, I have yet to see anything to conquer beyond Bender's Hill, or at least nothing that I myself might overcome with reform or influence by statecraft or business acumen. Others too have given up Bender's Hill as a necessary topographical obstruction and have done nothing about it.

It is true that I have traveled beyond Bender's Hill in my time and have glimpsed quaint places here and there, by dint of my own foot-pushing on an accelerator for the most part; and it is also true that I have crumpled up my lean anatomy in many a top bunk of overnight coaches, tasting cinders and smoke in full measure.

But I have had few, if any, romantic journeys or jaunts of a jousting character, in which I might fulfill the heroic part I visioned as a youth, as that which all happy travelers by right enjoyed. My thithers and yons have been of a most mundane kind, except twice or thrice when accompanied by trusting members of my family, who looked to me to supply what essence of adventure the gas stations and restrooms lacked.

To put it bluntly, I have never got beyond Bender's Hill in any conquering mood or bent upon any grand errand of sacrifice or glory. In other words, while I have caught some trains since my boyhood wistfulness, I have sort of missed the bus on highways of zestful enterprise. I have come and gone and watched and seen, but seldom conquered.

Right now I stand just where I did as a lad beside the mystic and glamorous railway. I am somewhat like I was then because I am obliged to linger and watch others take that train and seek glory and knowledge and honor in a strange quest beyond the homeland.

All around us in my town are lads training for grim duty. Others have waved farewell and are gone. Still others send censored notes replete with strange names and stranger facts. All I can do is to limp over to the city library and hunt for books that permit me to follow in their wake a ways. And the following is not so good for a guy whose patience with maps and footnotes and bibliographical references fades away an hour or so after dinner.

Still, I am not bothered much over inaction or not being in the tide of onslaught. I do not crave for medals or yearn to take prisoners. I have no strong notions yet as to how high we should hang the Axis, although I agree it must be efficiently done. It is the listlessness of mental sterility and the awareness of being too ignorant for a knowing world that worries me most.

I DREAD being taken some day for a somnolent Rip Van Winkle come to life, who will be as badly outmoded in 1945 as my old car is now. For as I see it, the youth of today has not so much to fear from being a physical target for somebody's gun as he has to feel elated over being in a period of life when quick aptitude for fresh facts and new skills enables him to keep step with the coming Renaissance.

So I come at last to my text of the times—that we are entering another Revival of Learning, a new and revitalized world recovery, an era that will usher in

the best of prizes for those who stand prepared and ready. I would like to be aboard the train bound for the Renaissance, but to date my ticket is being reserved for another and a younger party. Perchance, I may see some of the facts he uncovers through his tales of a new and fabulous Wonderland, which in due time may even transform Bender's Hill. I know it will be transformed if some of those returning Crusaders carry a sort of Holy Grail to lighten the pathway leading over and beyond the limits of my tender years.

As we look about us, we find we are entering a period when the main thesis is put on Production and Action, and all manner of subjects allied thereto. It is nothing if not brutally practical and workable. But underneath it one senses a strong fiber of Religion and Faith, such as we have not witnessed in many years. What seem to be temporarily knocked out of the picture are the literary, poetic, and cultural studies. In my town, a college famed for the latter courses must give way to hosts of recruits in hard training for war technology, leaving the bards and the artists gathering dust in the storerooms.

But why grouch because for a while Mars has outshone Minerva? Why worry at this hint of decadence? We know that the first task is to make the world rather safe and clean again, upon which we may return with greater depths of productive capacity to the poetic and cultural arts and crafts.

Moreover, one who has felt the pangs of suffering and sacrifice and defeat can best wield the pen and use the brush to lengthen the scroll of creative art that really lives forever. Just glance at some of the drivel and dirt we fed upon as literature and art during the depression decade, and you'll see that it takes guts to make genius appreciated, the kind of genius we are going to find among us when the war is over and peace is made secure. Yes, I even anticipate that we will develop some noteworthy poets and mural painters in the homely shadow of Bender's Hill, after they get done with Tokyo and Berlin.

If we get a Renaissance, some folks will say it has been won with far too great a price in blood and bravery. There will be many men of valor whose relatives and friends will watch in vain for them to be numbered among the returning passengers on the train that brings us in the Renaissance.

Over against that sad issue it may also be said that those of us who remain to welcome the Renaissance will have some penalties to pay and some quiet sacrifice to make in our own way; and likewise, that it may be better to lay down your life in a troublesome world than to live without helping to correct it.

It is not likely that the people who lived back in the Middle Ages were able to sense the turning point in human aspirations and ideals which has been called "the Renaissance." We, likewise, may not be aware of the deep-flowing tide that is carrying the races of man forward to a different and, we hope, a more progressive and enlightened age.

Although strictly speaking, the Renaissance is usually considered as having its first full flower in Italian art, commerce, and literature, we may regard

(*Turn to page* 51)

Crotalaria—A Crop That Grows Like Weeds

By R. Y. Bailey

Chief, Regional Agronomy Division, Soil Conservation Service, Spartanburg, S. C.

GENERATIONS of farmers have wished for a crop that would grow like weeds. On an increasing number of Southeastern farms, crotalaria is making this wish come true.

In addition to its weed-like growth, this legume also serves the double purpose of reducing soil erosion and increasing soil fertility. The ground cover provided by a good crop of crotalaria grown following small grain or after the last cultivation of corn protects the soil against erosion during the winter months. The nitrogen and organic matter from one or more crops of crotalaria greatly increase yields of corn, cotton, peanuts, and other crops on poor sandy soils.

The performance of crotalaria has been all the more remarkable because it does not require any radical changes in farmers' regular practices. Neither do cropping systems and fertilizer practices have to be greatly altered. Unlike most other legumes that have been introduced into the South, it did not even require inoculation of its seed.

Farmers simply plant crotalaria once, often sowing the seed by hand. Seed produced by the first crop shatters out, remains on the land, and thus insures reseeding in succeeding years. The one direct seeding is usually made as an interplanting with corn, or as an early spring seeding on small grain.

Crotalaria has a remarkable weed-like ability to come back after clean cultivation, or when a very dry season prevents

Seed will be harvested from this 30-acre field of *crotalaria spectabilis* in Okaloosa County, Fla. More than 20 head of cattle grazed the native grasses that grew among this crotalaria the past summer.

William S. Ward, Pinermount, Fla., in pickup, grew 35 bushels of corn an acre (left) following crotalaria. Corn on the right grown on similar soil without crotalaria made 17½ bushels per acre.

it from making a crop of seed during any one year. The following year, if conditions are favorable, a stand comes up from hard seed that failed to germinate.

Strange as it may seem, farmers have increased their success with crotalaria by doing less work. They obtained thicker stands and more vigorous growth of this legume where cultivation of corn was completed when plants were about waist high than where cultivation was continued until the plants were bunching to tassel. This required one less cultivation than is usually given corn. The omission of the cultivation has not appeared to reduce the yield of corn. In several trials, the last cultivation of cotton was omitted on a few rows. The growth of crotalaria was similar to that obtained where corn was "laid by" early. Further study will be necessary in order to determine how omitting the last cultivation normally given cotton will affect its yield.

The excellent seed-producing characteristics of crotalaria greatly simplified its distribution over a large acreage in a relatively short period of years.

In the spring of 1937, W. M. Guest, of Gainesville, Ga., planted 15 lbs. of *Crotalaria spectabilis* seed in alternate rows with corn on three-fourths of an acre, as a field trial in cooperation with the Soil Conservation Service. In the fall, he picked 900 lbs. of seed. By 1942, he had expanded to approximately 100 acres of crotalaria, and from a part of the acreage he harvested more than 10,000 lbs. of seed.

Mr. Guest has shipped seed to both North Carolina and South Carolina, as well as to several adjoining counties in Georgia. It is estimated that there were 2,000 to 3,000 acres of the crop in northeast Georgia in 1942 that resulted from the modest beginning in 1937 with 15 lbs. of seed. Most of this acreage is in the Upper Chattahoochee soil conservation district with which Mr. Guest cooperates.

Crotalaria is so prevalent in both Suwanee and Madison counties in Florida that in the fall, when it is in bloom, cultivated fields present the appearance of huge yellow blankets spread over the landscape. County Agent S. C. Kierce of Suwanee county estimates that 15 per cent of the cropland in that county is seeded to it.

In Madison County, County Agent S. L. Brothers estimates that 20 per cent

Picking approximately a bale of cotton per acre following *crotalaria striata* in Richmond County, N. C. This sandy field usually made less than a half bale per acre before it was planted to crotalaria.

of the cropland is in crotalaria. In many cases it was seeded by the simple process of breaking the seed heads from plants growing along the sides of county roads, hauling them to the fields on tobacco sleds, and scattering them over the cropland.

In the Sandhill area of Richmond County, N. C., the acreage of crotalaria was increased from less than 200 acres in 1936 to approximately 30,000 acres in 1941. This was approximately 40 per cent of the cropland in the county.

Striking increases in crop yields following crotalaria have been obtained on poor, sandy soils. Much of this land is so poor that it would be difficult to grow a satisfactory crop of most of the annual winter and summer legumes. Many fields are so sandy that only indifferent success has been obtained with lespedeza seeded on small grain, or with cowpeas or soybeans following the harvesting of grain. A few of the many examples of increased crop yields following crotalaria may be of interest.

In 1937, J. A. Fortner, of Dowling Park, Fla., planted corn on two acres where crotalaria had grown the past three years and produced 28 bushels per acre. On two adjoining acres of similar land where the legume had not been grown the yield was eight bushels an acre.

On the farm of W. P. McRae, of Richmond County, N. C., a tenant, who for several years had been producing an average of five bales of cotton on 15 acres of very poor sandy land, reduced his acreage in 1934 to 10 acres. Under the guidance of Mr. McRae, his tenant began planting crotalaria at about the same time he reduced his cotton acreage. He has since averaged 10 bales per year on his 10 acres following crotalaria.

Crotalaria is being used rather extensively as a cover crop in peach orchards in North Carolina and South Carolina. D. L. White, McBee, S. C., a successful peach grower, plants crotalaria in his orchards. His trees show unusual vigor and remain in production longer than trees on similar soils where the crop is not grown.

Crotalaria is making a direct contribution to war production through increased yields of peanuts. Where peanuts are planted after it, the yields of peanuts are considerably increased over the yields on similar soils where it has not been grown.

W. M. Pitchford, Columbia, Ala., planted corn and crotalaria on a portion of a large field in 1940. Corn was planted again in 1941 and a good crop of crotalaria grew after the last cultivation of corn. The entire field was planted to peanuts in 1942. On the portion of the field where peanuts followed two crops of crotalaria, the yield was 1,829 lbs. per acre. This was 500 lbs. more than the 1,307 lbs. per acre produced on the portion of the field where no crotalaria had grown. The peanuts grown after it were graded as No. 1; whereas, those grown in the other portion of the field were graded as No. 2.

Due largely to an unusually rainy cultivating season, there was a considerable amount of crotalaria in the peanuts at harvest time. When asked whether this would interfere with the harvesting, Mr. Pitchford said, "It will be no worse than beggarweed and other weeds and grass in the peanuts, and look at the good it has done."

The adage, "Fools rush in where angels fear to tread," might well apply to one who even suggests the possibility of growing flue-cured tobacco immediately after a legume. Still, farmers in North Carolina and Florida are growing tobacco after crotalaria on light sandy soils and seem to be getting away with it. In fact, a number of tobacco farmers in the Sandhill section of North Carolina have reported larger acre yields of tobacco that sold for a higher price per acre after crotalaria than they or their neighbors made on similar land where the legume had not been grown.

Harvey Young, Ellerbee, N. C., sold his tobacco from two acres following crotalaria for $431 an acre compared with a return of $250 an acre from tobacco that was grown on similar land in a cropping system where crotalaria was omitted.

Russel Flowers, Madison, Fla., scattered seed heads gathered from crotalaria plants growing along the roadside over 5.2 acres of poor land that he said had been, "peanutted to death." He planted rye on this field the next two years and volunteer crotalaria grew after the rye. After two years of rye and crotalaria on this field, he planted it to tobacco and produced 1,300 lbs. per acre. He sold his tobacco for $400.85 an acre. Four of his neighbors grew a

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Tobacco on the right that was grown on dry, sandy soil following crotalaria made a greater yield and sold for a higher price per pound than that on the left grown on a similar soil without crotalaria. The tobacco was grown by Lee Lovin, Ellerbee, N. C.

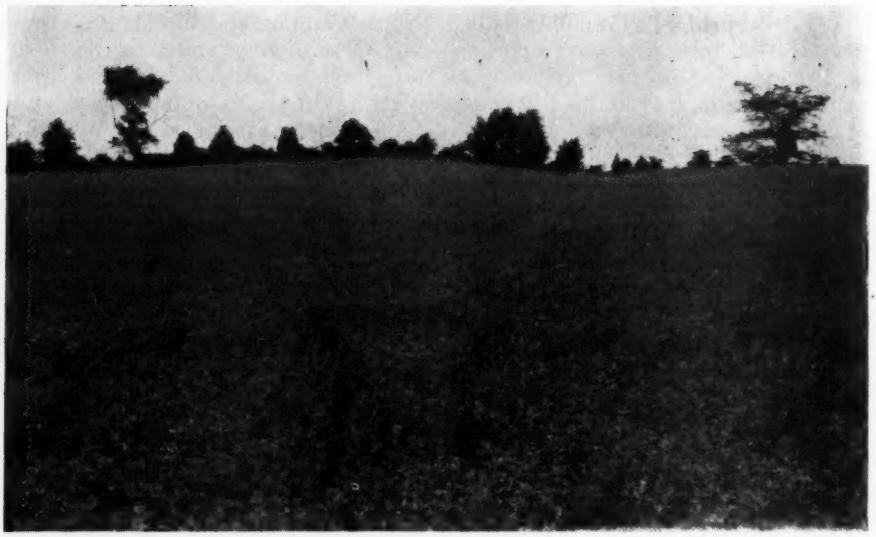

Fig. 1. Alfalfa is on the march in Tennessee. Wartime need for greater quality hay and pasture production for livestock feed and knowledge of fertilizer practices for successful production are responsible.

Borax for Alfalfa in Tennessee

By H. E. Hendricks

Agricultural Extension Service, University of Tennessee, Knoxville, Tenn.

FOUR years of test demonstration results obtained by the Tennessee Agricultural Extension Service, in cooperation with the Experiment Station, have brought to light new information on how to fertilize alfalfa in this State. We have known for many years that the soils in Tennessee generally require treatment for successful alfalfa production, and early in the history of extension work in this State demonstrations were common showing that alfalfa could be produced by the use of limestone and phosphate.

Anyone having experience in extension work in the southeastern states is familiar with the fact that, as a rule, these old demonstrations show that alfalfa was frequently a complete failure where limestone was not used. Similarly, where phosphate was omitted from the demonstrations on phosphate—deficient soils, the alfalfa either failed completely the first year or the yields were so low as to make the crop unprofitable. Even with the use of limestone and phosphate, however, and in many instances where stable manure was added and where soils were selected that were most adapted to alfalfa, the crop was not as successful over a period of years as we hoped it would be. It was noted that where alfalfa was produced in considerable quantities on the same farm

Fig. 2. A typical alfalfa field in its third year—too poor to leave, but too good to plow up.

and where it was grown successively on the same land, the life of the stand became progressively shorter so that the older alfalfa growers were generally the ones who called to our attention the fact that alfalfa was gradually becoming more difficult to grow in the State of Tennessee.

It is recalled by the writer that in 1938, at the Middle Tennessee Farmers' Institute at Columbia, in the heart of the alfalfa-producing belt in this State, a farmer from Robertson County came to the Institute for diagnosis of a sample of alfalfa that was diseased, or apparently unhealthy in its growth and appearance. He stated that he came to the Institute for the particular purpose of securing information on how to correct his alfalfa trouble. The agricultural workers attending the Institute made a number of recommendations which might cure the ills of his crop; however, in nearly every instance the farmer stated that the recommendations given had already been carried out. Finally he stated that he was convinced no one there knew what was the trouble with his alfalfa field; but he was sure that there was some chemical, which if applied to his land, would supply something that was not available there at present. The farmer was right. The trouble with his alfalfa was typical boron deficiency, but no one knew it at that time.

During the past four years, the county agents in this State have demonstrated the use of not only lime and phosphate but also borax and potash from the four corners of the State. The range of soils and climatic conditions were as varied as could be found in any state, proceeding from the Great Smoky Mountains on the East, with an elevation of over 5,000 feet, across the Great East Tennessee Valley, over the Cumberland Plateau, into the Central Basin or Blue Grass Region of the State and its surrounding Highland Rim, into the Coastal Plain soils of West Tennessee, then over into the loessal soils of the western portion of the State and even into the Mississippi River Delta, with an elevation of less than 400 feet. The east-west length of this area is more than 550 miles.

In looking over the reports now on my desk, received from county agents who were in charge of these demonstrations or from farmers who were carrying them out, I am reminded of adver-

tising testimonials of a patent medicine. There has been no contribution to Tennessee agriculture in recent years that has given as spectacular results, or that has been accepted by alfalfa growers without question, as has the use of borax. In 1942, over 90 per cent of the demonstrations established have shown significant response where borax was applied, and a large percentage showed additional increases where potash was used with borax. In many cases, the yield of hay was more than doubled by actual dry-weight measurement. Borax gave by far the greatest response per dollar invested in the treatment. There is quoted below the average hay yields by cuttings for the 43 demonstrations that have been reported:

	1st Cutting	2nd Cutting	3rd Cutting	4th Cutting	Total Cutting
Ck*	838	1368	1035	1019	4260
B, 20#	1020	1741	1347	1240	5348
B, 20#—KCl, 200#	1160	1986	1489	1413	6048
KCl, 200#	1043	1687	1306	1290	5326

* All plots received farmer's normal lime and fertilizer treatment. In all cases lime was used, and except in Central Basin, phosphate was used. In a few cases manure also was used.

The increase in the yield of hay from the use of these treatments, particularly borax, is not the most significant fact that has been brought out by these demonstrations. A matter of still greater importance is that by the use of these materials, alfalfa can be produced successfully on land that heretofore has been considered unadapted to alfalfa production.

It is not meant to leave the impression that by the use of soil treatment alfalfa can be successfully produced on any type of soil; but the borax treatment particularly, and this applies also to potash to a lesser extent, has responded most noticeably on land that is not so well adapted to alfalfa. This has been noticed on extremely droughty land or land that has a tendency to be a little wet. Neither should there be the impression that these materials fail to show up on land well adapted to alfalfa; however, it is recognized that there is land in this State that grows alfalfa so well, either with no treatment or with treatments of limestone or phosphate, that very little response can be expected from anything else. For example, in the Mississippi River Delta, there is land from which no response can be obtained from any treatment, even stable manure; and on some of our other well-drained fertile bottom lands little response from additional treatment is noted until after two or three years. However, even in the Mississippi River Delta when the stand of alfalfa reaches above the third year, typical boron deficiency frequently appears.

Added to the increase in hay yield which has been obtained from the use of borax and potash in the demonstrational work that has been carried on, there is a noticeable increase in the life of the stand of the alfalfa. This seems to be more particularly true where borax is applied and even greater where borax and potash are applied together. As a matter of fact, these two materials seem to complement each other in the results obtained from their use somewhat the same as we have always noted from the use of lime and phosphate.

It is not definitely known just what percentage increase will be obtained in the life of the stand from the use of borax and potash. In many instances, where alfalfa is actually being produced on land that is thought to be adapted, it is safe to say that this treatment has added 50 per cent to the life of the stand. In other cases, from single applications, it might be safer to say the life of the stand may be increased 25 per

cent. The effect of additional applications in this State has not proceeded long enough to make this determination. It is certain, however, that the average life of the stand from even borax alone can be increased from our present average of three years, to four or even five years, and the fifth year be as good alfalfa as ordinarily would be the case in the third year. This factor is very significant in view of cost of land preparation, seed, seeding, and the use of the land during this period.

Then, the quality of the alfalfa hay, which is produced on the treated portions of these demonstrations as compared to the untreated portions, has been outstanding. This matter has been called to our attention a number of times by our demonstrators who have pointed out that in addition to, for example, a 50 per cent increase in tonnage of hay at a certain cutting, the alfalfa on the treated portion was green at time of cutting and cured into extra green, extra leafy hay; whereas, the alfalfa leaves on the untreated portion had turned yellow at time of cutting and resulted in discolored and stemmy hay. An appraisal of this factor at present is somewhat indefinite; and yet, no doubt it is worthy of note.

Alfalfa in Tennessee is also frequently pastured. At the time this pasture is most needed by livestock producers, we are in the midst of an extreme drought, which is responsible for a depletion of other pastures and, therefore, the greater need to turn the stock in on alfalfa. From reports received on many of the demonstrations which were pastured for a period of time during the past summer, it is evident that the added treatment of borax and potash will strengthen the alfalfa to such an extent that it will permit more pasturage without injury to the life of the stand. It is also reported that in many instances the demonstrators noticed that the stock had a tendency to graze a greater proportion of the time on the acreage in the field treated with borax and potash than on the untreated portions of the field, which seems to indicate that the herbage was more palatable.

In 1942, there was some evidence that by the use of borax on alfalfa Tennessee

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Fig. 3. Borax was applied to this field with a cyclone seeder. Note strip in the center of the field where application failed to meet.

For Hershey Orchards Complete Fertilizer

By B. T. Rutt

Hershey Estates, Hershey, Pa.

IT has been said the reaction of man to any step of progress, whether by invention or discovery, was first to condemn, then to allow it reluctantly, and finally to wholeheartedly support the improvement. The inference here is that the use of potassium in an orchard fertilization program is a real contribution to sound orchard practice. Just how far through the above steps have we come from our old practice of nitrogen only? It seems evident to me that we are following some such course of recognition.

Here at the Hershey Estates Orchards we have used a complete fertilizer for six seasons. It may be asked, how did we come to use a complete fertilizer? Answer—suspecting a calcium deficiency (the place had received no application of lime for many years) we had soil samples taken over the entire orchard. These samples were analyzed in our experimental laboratory by an experienced soil chemist. The results were far from those expected, it being thought that lime was needed, but contrary to this, there was no serious shortage of lime, most of the samples running a relatively high concentration of available calcium. A few blocks which were slightly low in calcium have since been given an application of pulverized limestone. As, of course, we received a complete analysis, the potassium deficiency was the startling thing. Every

McIntosh apple orchard at State College, Pa. Good covers of bluegrass or clover have always been grown. The trees have never lacked for nitrogen, phosphate, potash, and lime. Yields have been more than 500 bushels per acre for 8 years, and in 1942 a yield of 1,400 bushels per acre on a 5-acre block was secured.

sample showed very deficient. This was in line with results of most of the samples taken for the past several years on the farming land of the Hershey Farms.

It seemed very evident now that our former practice of a spring application of either nitrate of soda or cyanamid was not sufficient. Hence, our complete fertilizer program was begun and we are now certain it will be continued.

We embarked on this program before our trees showed any of the well-defined symptoms of prolonged deficiency related to extreme cases of potassium starvation. Such conditions would, we believe, always be related to very low tree vigor, from which recovery would have to be very slow and certainly not much improvement could be expected for at least several years. One factor of prime importance in the use of potash in the fertilization program would seem to be the method of application in order to get the fertilizer into the region of the feeding roots. This phase is now receiving our greatest attention and better means of application are expected to result.

Our first intentions in the use of the complete fertilizer were something of a compromise. We still attempted to get the unit of nitrogen per tree in an amount equal to our nitrogen-only program of previous years. We have gone quite some distance from this practice to that of keeping the cover crop in first consideration, knowing that if mowed and allowed to rot in the orchard, the trees will get theirs in turn. So it will be seen that this calls for broadcast application, usually about 400 pounds per acre.

We have gone through several formulas seeking the most desirable one. These were 10-6-5 (our starting formula), 9-9-6, 5-10-8, and what we believe will be our preferred one—10-6-9.

While it may still be too early to speak of results, nevertheless there are some very astonishing things evident. On one block of York apple trees about 30 years old which had the "on" and "off" habit of bearing, complete fertilizer has evidently done much to improve the general tree vitality and at the same time has given strong indication of helping us away from the "no crop"—"big crop" habit of bearing.

Severe potash deficiency in the apple shoot at the right shows the short, slender growth and burned leaves characteristic of severe potash shortage.

A production record on this block previous to our application of a complete fertilizer would run from 400 to 2,500 bushels on the "off" year and from 7,000 to 10,000 on the "on" year. The first year we used the complete fertilizer, being the "on" year, we had 7,100 bushels. The second year, being the "off" year, we had 2,400 bushels. The third year being "crop" year, the yield was 7,500 bushels. We were really amazed when the fourth year (1940), the old "off" year, came through with 4,200 bushels. Such a yield was never associated with the "off" year. This was the year (1940) when some of the old orchard hands tried to persuade the management that it was a waste of money to apply the after-bloom sprays.

As any orchard man knows, it is quite easy to overlook the little apples

in a light set at petal fall time. The men on the job here simply did a good job of this "overlooking" in the early season. At harvest there were a few reminders to the fellows who had bet they could eat all the apples it would give above 400 bushels!

The year 1941, the "on" year, found the trees with a full set. We really had hopes early in the season of approaching the old record of 10,000 bushels. However, as the season progressed it became increasingly drier until trees that stood on high ground actually wilted under their load of fruit and we harvested a crop of only 6,000 bushels. Of this 6,000 bushels 70 per cent were under 2½ inches. Actually 1,200 bushels were under 2¼ inches and very few above 2¾ inches. I would expect some folks to view the above report critically with a thought to some such corrective measure as timely thinning of the fruit. Defending the course taken I would say that help was not immediately available, but the prime reason no such procedure was followed lies within the realm of human limitation, namely: our inability to foresee the severe drought of the latter season at the time of fruit thinning. I neglected to say that early in the drought period the orchard management here had hopes of rigging up a system of irrigation (surface ditches). However, this proved too distant and did not materialize. That our hopes of having more uniform regular bearing on these old trees was not entirely in vain may be seen from the record cited above together with that of the present crop (1942) when we harvested 6,530 bushels on the "off" year. This was done with the full advantage of good size, having had ample rainfall, and the advantage of good healthy leaves.

It may be thought a far cry from orchard fertilization to worms, but while we have already brought in crop records (and sometimes I think that worms do have something to do with the quantity left on the tree until harvest time), it may be of interest to point out that the codling moth has not been a problem in our block of Yorks. Official count of 1,200 fruits by our State Entomologist in 1941 was 4 per cent codling moth. This includes stings as well as worms. In 1942 we had no official check-up but I am certain the worms and stung fruits were less than 4 per cent of the crop.

Certainly no treatise on orchard fertilization could mean anything unless taken in conjunction with such other operations as pruning and cultivation

Severe potash deficiency on the peach. The two shoots at the right are badly injured from lack of potash.

or cover cropping. While it is not possible for us to trace these operations back to the start of the orchard, we can go back to about 1927. This block stood in sod for about eight years dating from 1927, after which we began early spring (blossom time) cultivation on alternate years. This cultivation is not to be understood to have been clean but rather such that retains a good stubble mulch, to avoid erosion. It was then seeded at once to sweet clover and in turn mowed whenever it became too high. The pruning has been annual and had been moderate in extent. Ground

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Fertilizer attachment on a 2-bottom plow in action. Note placement of fertilizer in band on the plow sole.

Plow-Sole Fertilizers Make Good Showing

By C. J. Chapman

Soils Department, University of Wisconsin, Madison, Wis.

PLACING fertilizer on the plow sole with an attachment on the plow was tried for the first time in Wisconsin in 1942. This idea of applying fertilizer on the bottom of the furrow had been tried out in several other states in previous years. Dr. George Scarseth of Purdue University Agricultural Experiment Station has carried out extensive experiments under a wide range of crop and soil conditions in Indiana. His enthusiasm for this method of applying fertilizer has been caught by experiment station investigators with the result that we now have a large amount of data which very definitely indicate that this method of plow-sole placement of fertilizer is a practical and a most efficient means of supplying crops with their complete nutrient requirements and will usually result in the production of maximum yields under any given set of soil and climatic conditions.

The placement of fertilizer down on the plow sole at a depth of five to eight inches in concentrated bands appears to be a sane and sound idea. We know that the root systems of most all farm crops completely fill the surface plow layer and even go much deeper to secure adequate amounts of moisture to sustain growth during drouth periods.

Plant food to be available to growing crops must be in water-soluble form, and certainly we know that during periods of drouth this water-soluble plant

food must be derived and brought up from the lower root-feeding zone. Plant food applied in the surface inch or two of top soil is not going to keep our crops growing when the surface soil is as dry as ashes.

The results of Dr. Scarseth's work in Indiana and also those secured in other states were so outstanding and spectacular that we decided to demonstrate this method of applying fertilizer in Wisconsin in 1942. We tried it out chiefly on corn.

An attachment for a two-bottom plow was furnished by the International Harvester Company (one of several made up and distributed for demonstrational and experimental work throughout the United States). We set up seven demonstration plots on corn in Wisconsin. Two were harvested by farmers before we arrived; so data are available from only five of the seven. (See tabulation for results.)

In most all of these demonstrations we used the 10-10-10 mixture and applied it at the rate of about 700 pounds per acre. In some of the plots, starter fertilizer, 3-18-9 or 3-12-12, was applied in the hill in addition to the plow-under or plow-sole treatment. The effect of this small amount of starter fertilizer, applied in the hill with an attachment on the corn planter, has always made a spectacular showing in the early stages of growth. In our demonstrations, whether used as a supplement to plow-sole treatment or alone, the starter fertilizer did make a big difference in early growth; in fact, we observe from the results tabulated that this "in-the-hill" treatment alone resulted in good increases in yields in all cases. For many years in Wisconsin we have recommended the application of starter fertilizer for corn. Our soils are usually cold in the spring. We find that small applications at the time of planting with an attachment on the planter gets the corn off to a vigorous start, permits earlier cultivation and better weed control, and, of greatest importance, pushes and advances maturity in the fall. Yields are frequently increased by 5

On the Rufus Gillette farm at Mazomanie yields of corn were increased from 41 to 68 bushels per acre where 700 lbs. of 10-10-10 were applied on the plow sole.

and even 10 bushels per acre. We, of course, have always recommended this treatment as a supplement to regular applications of stable manure and/or plowed-down legume crops.

In those plots where this additional "in-the-hill" treatment was used along with the plow-sole application, we observed that the corn seemed to get its root system down into the plow-sole plant food and started feeding on the more abundant supply of nutrients at an earlier date.

The results of our demonstrations were not all consistent, but we do observe that there have been some rather outstanding and significant differences in yields due to the plow-sole treatment.

It appears that this new system of applying a high nitrogen-mixed fertilizer at heavy rates on the plow sole does offer a real opportunity to those farmers growing corn on the thinner, poorer soils in Wisconsin where manure is not available and where legume sod is not plowed under. Certainly the growers of hybrid seed corn who crowd their land pretty hard, and especially

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Boron Improves Canning Beets[1]

By R. Rexford Binnie[2]

Michigan State College, East Lansing, Mich.

COMMERCIAL canners have for several years been troubled by a condition in beets, known in various localities as canker, girdle, internal or physiological breakdown, and internal black spot. Due to its presence, canning operations have been retarded and canners have not only been obliged to use additional inspectors, but they have also faced the hazard of defective beets escaping detection and appearing in the final pack. Losses to growers are of two forms—dockage losses and low acre yields.

Many experiments by several investigators, both in this State (1) and others (4, 5, 7, 8), have indicated that this disorder may be greatly reduced by proper borax fertilization. This article reports the results of a recent experiment designed to study the effect of borax on the yield, quality, and composition of canning beets.

Canning beets were included in a field experiment, conducted in 1940, to determine the effect of borax on a number of field and garden crops. The experiment was located on an area of Thomas sandy loam on which signs of severe boron starvation in sugar beets were observed in 1939. The soil in this field contains free carbonates in the plowed layer, and the organic matter content ranges from 14 to 18 per cent. At a depth of 12 inches there is a 10-inch sandy layer overlying heavy clay.

One treatment included only an application of 3-12-12 fertilizer. Another treatment consisted of an application of 3-12-12 fertilizer together with a mixture of secondary fertilizer components other than boron. Other treatments included the 3-12-12 fertilizer and a mixture of secondary fertilizer components with borax supplied at the rates

Fig. 1. This plant, growing in pot culture, shows twisted, non-symmetrical leaves with cross-checked petioles, which are symptoms of boron starvation.

[1] *Contribution from the Soils Section, Michigan State College, East Lansing, Michigan. A portion of a thesis submitted to the faculty of Michigan State College in partial fulfillment of the requirements for the degree of master of science.*

[2] *Graduate Assistant in Soils. The writer expresses his appreciation to Drs. R. L. Cook and G. R. Muhr for guidance during the course of this study.*

TABLE 1.—THE EFFECT OF BORAX ON THE YIELD, QUALITY, AND CHEMICAL COMPOSITION OF CANNING BEETS.

Treatment	Rate of borax—pounds per acre	Yield tons	Per cent girdling	Chemical composition[2]									
				Per cent sucrose	Purity	Per cent nitrogen		Boron—p.p.m.		Per cent Fe_2O_3		Per cent ash	
						Tops	Roots	Tops	Roots	Tops	Roots	Tops	Roots
Control[1]	0	7.54	56.7	3.21	45.4	3.97	3.19	13.2	11.0	.4301	.1446	19.41	17.10
No borax	0	6.74	57.2	3.21	43.9	3.86	3.28	8.6	11.4	.3954	.1737	19.88	16.17
Borax	10	11.14	46.3	3.52	47.4	3.77	2.74	16.0	11.8	.4549	.1251	19.02	14.90
Borax	20	10.74	13.7	4.28	55.1	3.78	2.60	20.8	11.4	.4104	.1031	18.39	13.07
Borax	40	11.38	10.5	3.55	47.7	3.86	2.61	20.2	12.0	.4558	.1189	19.62	14.40
Borax	80	13.68	4.3	4.08	52.6	3.79	2.33	26.6	13.2	.4486	.1090	18.85	13.46
F value		5.73**	35.3 **	2.84*	6.09*	.68	26.5**	31.27**	.60	.70	5.41**	1.21	8.92**
F (5% point)		2.71	2.71	2.71	2.71	2.71	2.71	2.71	2.71	2.71	2.71	2.71	2.71
F (1% point)		4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10
Difference required for significance		3.17	12.3	.75	5.17	.27	.21	3.36	2.93	.090	.033	1.47	1.88

[1] *This treatment included only an application of 500 pounds of 3-12-12 fertilizer. The materials applied in all other treatments were uniform except for borax, and included the following materials at the rates per acre indicated: 3-12-12, 500 lbs.; NaI, 0.5 lbs.; $ZnSO_4$, 4 lbs.; $MgSO_4$, 25 lbs.; $MnSO_4$, 25 lbs.; $FeSO_4$, 2 lbs.; NaCl, 10 lbs.; and $CuSO_4$, 5 lbs. All treatments were replicated five times.*

[2] *The nitrogen, boron, iron, and ash contents were determined on tissue dried at 65° C. In taking the samples for these four determinations from the areas not receiving borax, an attempt was made to select beets showing girdling.*

* Significant to 5% point.

** Significant to 1% point.

of 10, 20, 40, and 80 pounds per acre. All treatments were replicated five times and were arranged in randomized blocks. The fertilizers were drilled at a depth of about two inches with a grain drill; the field was then disked and harrowed before planting. The data which appear in Table 1 are the results of the field experiment and of the chemical analyses included in this study.

The application of borax in this experiment resulted in highly significant increases in the yield of beets. The yield with the application of 80 pounds of borax was 91 per cent greater than the average yield of the two treatments without borax. Since the greater rates of borax application caused no decrease in yield, it may reasonably be assumed that the application of borax at rates up to 80 pounds per acre was not injurious to canning beets on this soil. In fact, it seems possible that a greater increase might have resulted from a still heavier application of borax.

It became apparent as the season progressed that the beets in the areas not treated with borax were not receiving adequate boron. One indication was the more intense red coloration of the leaves of these plants. This condition was not easily detected from observations of single plants, but there was a noticeable difference in redness when beets in borax-treated areas were compared from a distance with those in areas not treated with borax.

Certain other leaf symptoms also gave evidence of boron starvation. One of these symptoms was the stimulated initiation of leaves at the center of the crown. These leaves failed to attain normal size and shape and were dwarfed, twisted, and non-symmetrical. The upper surfaces of the petioles were frequently cracked and cross-checked. These symptoms are apparent in Fig. 1.

At the time of harvest marked differences were found in the quality of the beets. Cankers were common on the roots of those which had not received adequate boron. In extreme cases, cankers, at or slightly below the soil line, had completely encircled the roots, and a girdled condition had resulted (Fig. 2).

When the girdled roots were sliced horizontally, the dark, necrotic areas were found to be principally confined to an irregular but usually quite narrow zone near the periphery. The affected zones are prominent in the sliced beets in the two rows on the right of Fig. 3. Isolated necrotic areas sometimes oc-

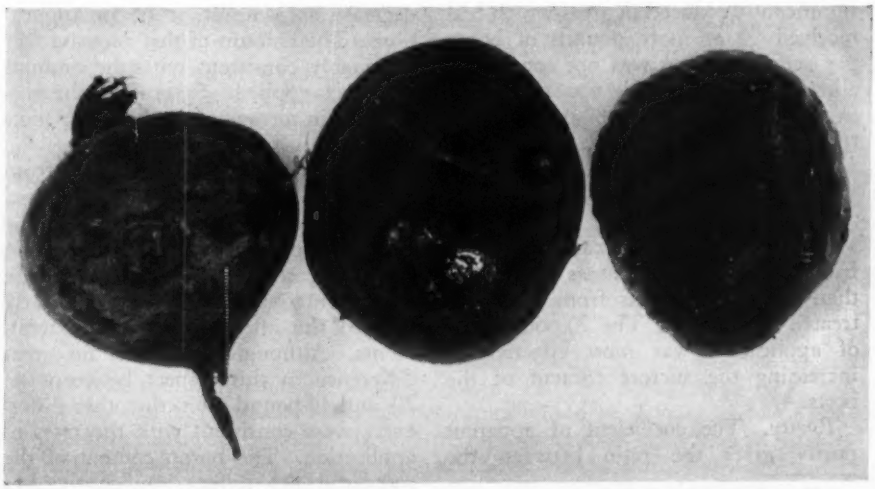

Fig. 2. Although these beets are not completely girdled, the external cankers are plainly visible.

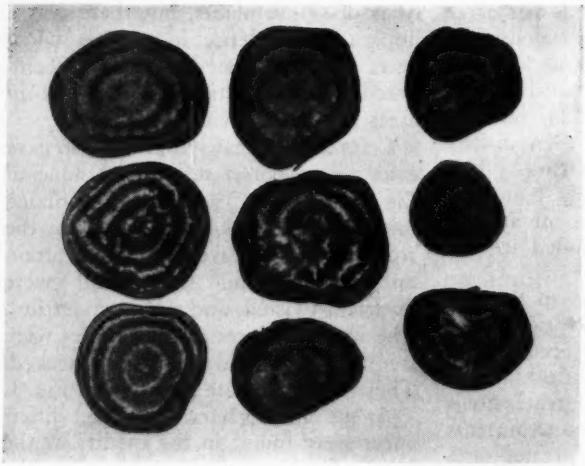

Fig. 3. Girdled roots show dark, necrotic areas, which are usually confined to a narrow zone near the periphery.

curred in the internal regions, but such instances were uncommon.

The percentage of beets showing partial or complete girdling was determined for each treatment. As shown in Table 1, girdling affected an average of nearly 57 per cent of the beets in the areas which had not received borax. The percentage of affected beets in the areas which had received 10 pounds of borax per acre was not significantly lower than that of the beets in the areas not treated with borax. The percentage was significantly reduced in areas which had received 20 or more pounds of borax per acre. Girdling was not completely eliminated, although it was not found in two replicates of the 80-pound borax treatment.

Chemical Composition

*Sucrose.** The sucrose content of beets from the borax-treated areas was higher than that of the beets from areas not treated with borax. The 20-pound rate of application was most effective in increasing the sucrose content of the beets.

Purity. The coefficient of apparent purity gives the ratio between the amount of sucrose in solution in the juice and the total soluble substances in the juice. The effect of borax on the purity of the beets was similar to its effect on the sucrose content. Since purity expresses a proportion, its value will change when either of its components changes. The data were examined to determine whether the increase in purity was partly due to a decrease in the total soluble substances in the juice. These substances, other than sucrose, probably are mainly nitrogenous compounds. It was found that the total amount of soluble substances remained nearly constant; therefore, the increase in purity was due entirely to a corresponding increase in sucrose content.

Nitrogen. The average nitrogen content of the beet tops from areas without borax was slightly higher than that of tops from borax-treated areas. This difference, however, was not great enough to be significant. The nitrogen content of the roots showed a greater decrease as a result of borax applications. The amount of this decrease was reasonably consistent with the amount of borax applied. Several of the differences in nitrogen content of the roots were highly significant.

Boron. The sample of beet tops from one of the control replicates contained 21 p.p.m. of boron. This caused the mean boron content for this treatment to be unreasonably high. The increase in boron content of the tops clearly showed the effect of the borax treatments. Although there was no great difference in this respect between the 20- and 40-pound rates, the other differences were consistent with the rates of application. The boron content of the roots did not differ significantly, but

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* *The writer acknowledges the courtesy of J. G. Lill in making the sucrose determinations.*

Fig. 1. Pasture mixture of alfalfa, sweet clover, lespedeza, red clover, timothy, and Kentucky bluegrass on a Jefferson County, Illinois, farm. Land limed and fertilized.

Quality in Grasses for Pasture and Hay

By H. J. Snider

Department of Agronomy, University of Illinois, Urbana, Ill.

THE market value of hay, as a rule, is based entirely on external factors, such as freedom of weed contamination, color spoilage, and some others. On this basis one ton of hay, timothy for example, is equal in value to every other ton of hay made from this species of grass. Apparently, the market does not allow a price differential in favor of the possible higher feeding value in hay due to some special soil condition such as a high level of natural fertility or special fertilization, or both of these together.

It has been found by chemical analysis that one ton of Kentucky bluegrass hay from land having rather liberal fertilization contained 365 pounds of protein, while a ton of bluegrass removed from adjoining unfertilized land contained only 162 pounds of protein. Another difference which affected the feeding value of these two samples of hay was the mineral content. The ton of hay from the fertilized land contained 61 pounds of minerals, while the ton from the unfertilized land contained only 37 pounds. These minerals were composed of phosphorus, potassium, calcium, magnesium, iron, and manganese. Minerals such as these have proven of great value in animal nutrition and represent a value in grasses which should not be overlooked. In the bale, these two hay samples would be very much the same in appearance and, according to market standards, might easily be in the same grade and sell at the same price.

The type of soil upon which Ken-

tucky bluegrass grows was found to have an effect upon its feeding value. In 1941 on untreated Ava silt loam soil in southern Illinois, bluegrass hay was found to contain 144 pounds of protein and 31 pounds of minerals per ton. On Harpster clay loam in central Illinois, bluegrass hay was found to contain 185 pounds of protein and 45 pounds of minerals per ton. In both these cases the hay was harvested at the same stage of maturity and was from untreated soil.

Association with legumes has an effect on the composition of grasses. On well-fertilized land at Urbana, it was found that redtop grown alone contained 162 pounds of protein and 43 pounds of minerals per ton. When redtop was grown with alsike clover, the redtop hay contained 186 pounds of protein and 47 pounds of minerals per ton. In this same set of tests timothy alone was found to contain 118 pounds of protein and 35 pounds of minerals per ton. When grown in association with alsike clover, the timothy hay contained 174 pounds of protein and 44 pounds of minerals per ton. Mixtures of legumes and grasses make an ideal pasture and also excellent hay, but the fact that the grasses are themselves enriched by this association is very significant. In this experiment common white clover was one of the legumes used in the mixtures with grasses; this clover was among the most effective of the legumes in enriching the associated grasses. This common white clover frequently grows wild in pastures, and its presence should be looked upon as an advantage because it may greatly enrich the grasses both in protein and mineral content.

Reports come from many sections regarding serious injury to livestock which feed too much and too long on grasses and other plants grown on phosphorus-deficient soils so that the animals' diet may be decidedly deficient in phosphorus. Ava silt loam in southern Illinois is decidedly deficient in available phosphorus. Kentucky bluegrass grown on this soil has been found to run as low as 1.5 to 2 pounds of phosphorus per ton of hay. Bluegrass grown on more fertile Illinois soils, untreated, has been found to contain 3 to 4.5 pounds of phosphorus per ton which are increases of 100 to 125 per cent over the Ava soils. Other grasses such as timothy, redtop, and orchard

Fig. 2. This 30-year-old Kentucky bluegrass in Gallatin County, Illinois, was rejuvenated with lime and fertilizer, and seeding of lespedeza, sweet clover, and red top.

grass have been found to be correspondingly low in phosphorus on the Ava silt loam soil. It is not uncommon to double the phosphorus content of the above-named grasses by the addition of relatively small amounts of superphosphate and other phosphates.

Table 1.—Composition of Kentucky Bluegrass Hay

Soil treatment	Hay lbs./A	Pounds per ton of air dry hay						
		Protein	Phosphorus	Potassium	Calcium	Magnesium	Iron	Manganese
None	860	150	3.2	31.2	6.0	4.4	.20	.59
N	1830	212	3.2	36.4	5.2	4.8	.38	.46
P	1120	161	5.8	32.0	5.1	4.6	.10	.38
NP	1970	226	6.4	37.2	5.2	4.8	.46	.46
NPK	2080	210	6.2	46.2	5.0	4.4	.58	.40

N Ammonium sulphate, 200 pounds annual. K Muriate of potash, 200 pounds annual.
P 0-45-0, 200 pounds annual.

For increasing yield and protein content of grasses and hay, the use of nitrogen fertilizers has been found to be the most effective on Illinois corn-belt soils, although other fertilizing constituents have added to the protein content. On the Clayton experiment field, Table 1, the use of ammonium sulphate at the annual rate of 200 pounds per acre more than doubled the hay yield in pounds an acre and added 62 pounds per ton to the protein content of the hay, which represents a 41 per cent increase over that of the untreated hay.

In this field test, the addition of treble superphosphate (0-45-0) added slightly to the yield and to the protein content of the hay. Apparently, one of the greatest values of the applied phosphate on this soil was to increase the phosphorus content of the hay. In one case, this increase amounted to exactly 100 per cent, which is a considerable amount of phosphorus added to a crop such as Kentucky bluegrass. This soil was not especially deficient in available phosphorus, although the amount found in the soil was relatively low.

Potash applied to the soil gave some increase in yield and a rather large increase in potassium content of the grass. It was found in another experiment that the continued use of large amounts of ammonium sulphate had gradually reduced the amount of available potassium in the soil, and this, consequently, lowered the potassium content of the bluegrass hay. On this soil it is likely that if the use of ammonium sulphate is continued over a number of years, the effectiveness of the applied potash may become more apparent both in the yield and the composition of the grass.

This experiment, Table 1, was on what is known as Harrison silt loam. This untreated soil had a reaction of pH 5.6, and the use of ammonium sulphate after four years had reduced the reaction to pH 5.0.

Total nitrogen content of the untreated soil was 3,600 pounds an acre (two million pounds) which represents a reasonably productive corn-belt soil. The addition of 800 pounds of ammonium sulphate over a period of four years had not altered the total nitrogen content of the soil even in the top three-inch layer. Apparently the grass had fully utilized the amounts of nitrogen applied.

Soluble phosphorus in the untreated soil was found to be 20 pounds an acre, and the addition of superphosphate had greatly increased the amount in the surface layer. At the rate the phosphate was applied during four years,

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The Salt That Nearly Lost A War

By Neil M. Clark

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THE tanks these fighting men use have neither arms nor armor. The guns they man are aimed at solid rock. Their hard hats guard against boulders, not bomb fragments. Their uniforms are overalls, and their battle takes place far underground. They are 1000 miles from the Pacific, 2000 from the Atlantic, yet they are conducting a great offensive against the Axis. Day and night in a sun-baked desert they're getting out potash, a material that Hitler would give a big toe to deprive us of.

Lack of potash threatened to lose the last war for us; abundance of it is helping us to win this one. At the time of World War I, the Germans enjoyed a world monopoly. Embargoes cut off our supplies. By makeshifts we kept going—barely—but after the war we slipped back to imports. We could be as badly off for potash as for rubber right now, if a few farsighted people had not prodded and nagged us. As it is, there's enough potash in production within our borders to keep us going for a century and a half at least.

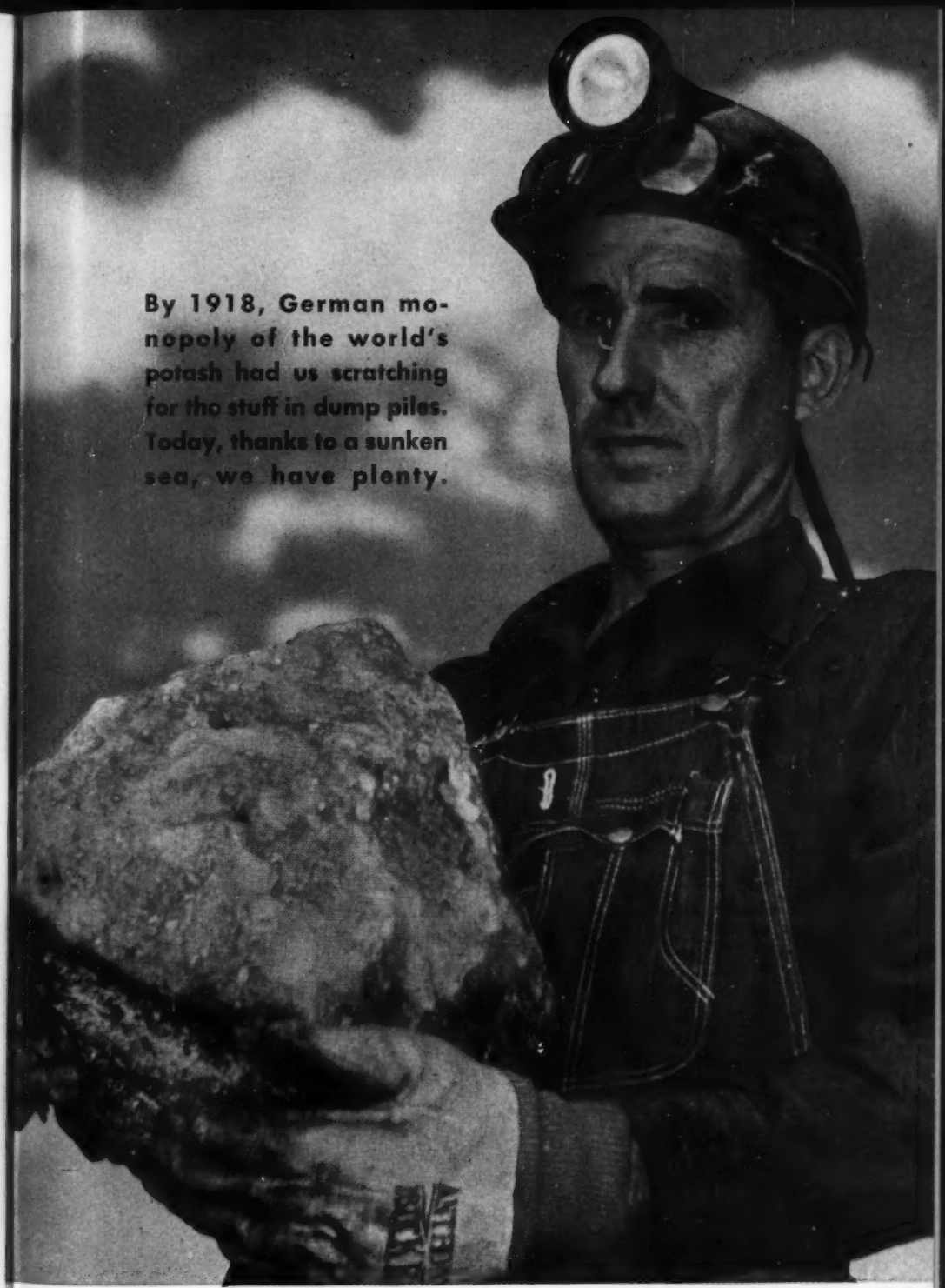
It's one of the biggest production stories of this war. Come to mesquite-greasewood-cactus flats twenty miles east of Carlsbad, New Mexico. Practically in the middle of nowhere, head frames rise gaunt against a turquoise sky accustomed only to Indians, cowboys and range steers.

Finding potash here was a miracle. Getting it out is a mining masterpiece.

The number of men employed in these mines is infinitesimal, compared with output. Everything that can be done mechanically is so done. Human hands need not touch this underground treasure at any point in the mining-concentrating-refining process. Machines do it all. Electric drills bore blasting holes. Undercutting machines bite nine feet into soft ore. Loading machines gulp up quarter-ton fragments of ore at a bite. Shuttle buggies on rubber carry ore a few rods to trolley-operated mine trains. There are automatic dumps on mine cars, gravity chutes to the skip. All kinds of conveyors carry the ore from crushers to brine tanks to drying accordions to storage to the railroad. Men press levers. That's all.

The ore is located 1000 feet underground. Shafts that deep are the only production bottlenecks: every ton of stuff has to come from below in five-ton skip-car lots. A cage above the skip carries workers to the bottom of the shaft in eighty-odd seconds. There they step into an unbelievable and beautiful underworld. Vanished oceans broke on beaches that disappeared here ages ago. Silt hardening into rock buried what the oceans left, and now men burrow to recover the old sea leavings. Streets make this underworld an orderly city. There's no timbering; the roof is supported by enormous pillars of untouched ore. Fresh air is carried to every nook by a huge blower system. There are no noxious gases or explosive dusts.

Potash occurs in several ores. This is sylvinite, one of the richest. In sunlight it looks like quartz, gem-flashing, reddish. On the tongue it tastes like salt. Salt it is, but not the kind in your salt shaker. Pure stuff refined out


By 1918, German monopoly of the world's potash had us scratching for the stuff in dump piles. Today, thanks to a sunken sea, we have plenty.

This is sylvinite, one of the potash ores. It looks like solidified cherry phosphate fresh from the drugstore fountain, but it tastes like salt and helps win wars.

Getting ready for a blowout. The electric gun bores pockets for explosive charges. After midnight the ore face will be blasted.

of this lovely ore is one part potassium, one part chlorine—KCl to the chemist. It's anybody's guess how much is down here—some experts say 300,000,000 tons in the one ore body now being nibbled at.

Potash is a peacetime product immeasurably important in war. Ninety per cent of the product goes to fertilizer factories and farms, for potash is one of the most important plant foods. Soils in which many of our best crops grow must be fed potash; otherwise they produce poorly, endangering the nation's

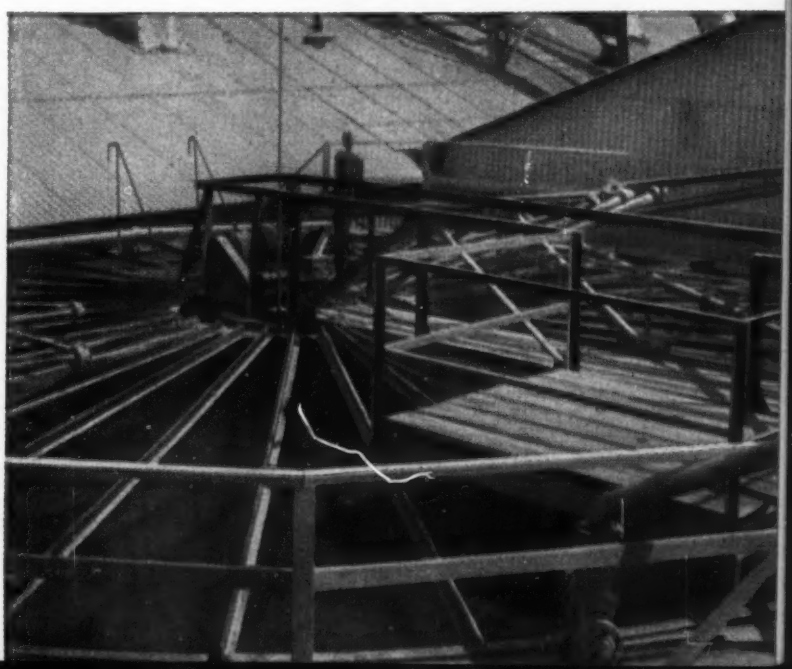
Substitute for a short-handled shovel. This mobile loader fills shuttle buggies with blasted ore at a multiple manpower rate.

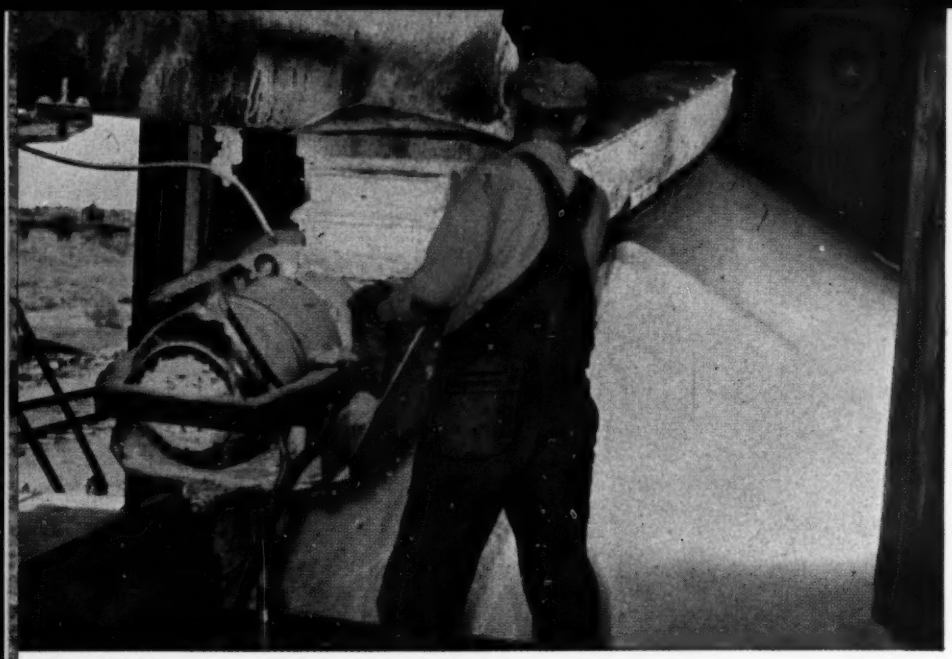
Another pictorial rarity—underground color photograph of a man waiting for a trolley. The trolleys carry ore to the mine shaft.

food supply. A 300-bushel-per-acre potato crop, for example, takes 170 pounds of potash out of the soil, and if it isn't put back, next year's potatoes are fewer and poorer. The remainder of our potash goes into vital manufactured products and processes, including glass, drugs, soap, matches, black powder, high-octane aviation gasoline and certain military fireworks.

The discovery of these potash fields was a result of World War I experience. Previous to that the Kalisyndikat, or German potash trust, controlled

Potash getting settled. Brine is settled in tanks like this and the desert-precious water is carefully saved.





Highly refined, chemical grade potash finds a berth in a boxcar. An automatic loading device packs it for the long trip to medical supply centers.

world production and regulated prices and supplies to strangle competition. In 1913 we imported approximately 1,000,000 tons of German potash salts. The inflow dried to a trickle in 1914, and prices jumped from thirty-five to as much as six hundred dollars per ton.

People began hunting for it everywhere. They recovered a little from cement and flue dusts, mined some from saline deposits in Nebraska, Utah and California. They got some from old mine tailings, from animal and vegetable wastes, from wood ash and sea-

(*Turn to page* 41)

What is left after the potash comes out. Waste is spread out in fields by bulldozers, may someday be used as cattle salt.

The Editors Talk

Agriculture in 1943

Agriculture in 1943 faces what undoubtedly will be one of its most crucial years in the history of North America. In both the United States and Canada, farmers will be called on to produce more with less facilities than they had last year. Agriculture will be on a full wartime basis, with calls for increased production of some crops and products and reduced production of others for which there is less need in the war effort or supplies of which already are in excess of our needs.

The U. S. Department of Agriculture goals for 1943 call for more dairy, meat, and poultry production. To feed these animals, more high quality forage such as corn and barley, oil-seed meals, and legume hay will be required. Full use should be made of pastures so as to let the animals feed themselves as much as possible and save labor. This will call for sound pasture improvement measures. Increased acreages of the oil crops, peanuts, soybeans, and flax, are urged, and these already were high in 1942. More dry edible beans, peas, potatoes, sweet potatoes, and certain vegetables are wanted. Some of these goals have already been increased over the goals first set up. While long staple cotton is needed in larger amounts, less short staple is wanted. Owing to large supplies on hand, less wheat is required, while tobacco goals are about the same as last year.

To do this tremendous job, farmers will have less help, and much less experienced help. Machinery and other supplies will be reduced, and nitrogen fertilizers will be somewhat lower in supply. On the helpful side will be the adequacy of lime, phosphate, and potash supplies. Demand for products will be strong, and prices will be good, probably in general somewhat higher than at present. The government has promised support of the market, and all the assistance possible in meeting labor and machinery needs. Fortunately it is becoming more and more recognized by top planning officials and the country at large that agriculture is one of the most important cogs in our war machine, and that it must be given proper consideration if the rest of the war machine is to function efficiently or even at all. Food is one of our first requirements, and for the purpose of feeding armies and large populations, it will not produce itself, even in the fabulous islands of the South Seas.

The entire program is on a voluntary basis, but governmental payments for growing the desired acreages of the wanted crops and bonus payments for growing increased acreages of these crops make it advantageous for farmers to make every effort to meet the goals. It will require every resource farmers can command. In some cases radical modification in farming practices will be necessary. In general, farmers are in good financial condition and are not afraid of the hard work that will be needed for the big job set out for them. If they are given the proper cooperation and support from the rest of the country and have an even break in the weather, they should be able to do what is being asked of Agriculture in 1943.

The Potash Journal

In line with the Government's urgent request for every possible conservation of paper, the American Potash Institute has discontinued for the duration the publication of *The Potash Journal*. The Journal was inaugurated in February 1937 with a purpose editorially set forth as follows:

"Accompanying the increasing importance of fertilizers in crop production is a growing volume of experimental and demonstration work with fertilizers. And in profitable crop production fertilizers must be used more and more efficiently. Thus there is an increasing need systematically to survey this field and present the results of such work from the point of view of the business man. It is the purpose of the Journal to do this.

"The Journal is, therefore, edited for all groups interested in the business and economic aspects of fertilizer use and consumption, as fertilizer merchants, economists, financial editors, agricultural workers, and others.

"While the content will relate particularly to potash use and consumption, it is appreciated that the successful use of potash depends on many factors in crop production, among which are other fertilizer materials and especially the use of mixed fertilizers of the proper ratios."

The more important topics to be discussed were listed as:

"1. The value of increases in crop yield and quality that have been derived from experimental and demonstration work with potash and fertilizers, related to the cost of the potash.

"2. Trends in fertilizer practices, changes in the use of important analyses of mixed fertilizers, the causes and relationship of such changes, from the economic viewpoint.

"3. State figures of fertilizer and potash consumption and their interpretation.

"4. Changes in crop acreage and other factors in relation to potash and fertilizer usage.

"In addition to these four topics, data of increasing importance in modern business activity, namely, series of index numbers of various kinds, will be given. Such indices are useful in showing changes in the general price level and also changes between important groups of prices. To be of the greatest value to the business man such indices, with reference to any particular industry, must be related and interpreted.

"5. It is, therefore, the purpose of *The Potash Journal* to present price indices of the important fertilizer materials. The index used is the result of research work covering a wide field and is complete from 1897 to date. The price the farmer received for his crops is a most important factor affecting the demand for fertilizers. Therefore, the prices of farm crops and other related prices and indices will be published regularly."

The statement of the purpose concluded with the hope that the broad field of economic and statistical thinking on the use and consumption of fertilizers can be interpreted in a practical and readable manner for those interested in the use of fertilizers.

That these broad aims fulfilled a considerable desire for this information was evidenced by a constantly growing mailing list. The Journal appeared regularly until early 1942, at which time more than 3,000 copies were being distributed.

Particularly, has there been evidence of appreciation for the four pages of statistics showing important trends and relationships—the present prices of fertilizer materials and a long-time trend of these prices; the relation of these prices, one group of fertilizer materials to another; the relation of the price of fertilizer materials as a single group to prices of other commodities, and the relation of fertilizer prices to the prices of the important crops. There is no other one source for this information summarized in this form.

It, therefore, has been decided by the American Potash Institute to incorporate this feature of *The Potash Journal* in BETTER CROPS WITH PLANT FOOD. We are pleased to present the four pages in this issue. The information will be brought up to date each month and we hope will be used not only by former Journal readers, but by an increasing number of the readers of this magazine.

Farm Prices of Farm Products*

	Cotton Cents per lb.	Tobacco Cents per lb.	Potatoes Cents per bu.	Sweet Potatoes Cents per bu.	Corn Cents per bu.	Wheat Cents per bu.	Hay Dollars per ton	Cottonseed Dollars per ton	Truck Crops
1910–14 Average	12.4	10.4	69.6	87.6	64.8	88.0	11.94	21.59	....
1920	32.1	17.3	249.5	175.7	144.2	224.1	21.26	51.73	....
1921	12.3	19.5	103.8	118.7	58.7	119.0	12.96	22.18	....
1922	18.9	22.8	96.7	104.8	58.5	103.2	11.68	35.04	....
1923	26.7	19.0	84.1	104.4	80.1	98.9	12.29	43.69	....
1924	27.6	19.0	87.0	137.0	91.2	110.5	13.28	38.34	....
1925	22.1	16.8	113.9	171.6	99.9	151.0	12.54	35.07	....
1926	15.1	17.9	185.7	156.3	69.9	135.1	13.06	27.20	....
1927	15.9	20.7	132.3	114.0	78.8	120.5	12.00	28.56	....
1928	18.6	20.0	82.9	112.3	89.1	113.4	10.63	37.70	....
1929	17.7	18.6	93.7	118.4	87.6	102.7	11.56	34.98	....
1930	12.4	12.9	124.4	115.8	78.0	80.9	11.31	26.25	....
1931	7.6	8.2	72.7	92.9	49.8	48.8	9.76	17.04	....
1932	5.8	10.5	43.3	57.2	28.1	38.8	7.53	9.74	....
1933	8.1	12.9	66.0	59.4	36.5	58.1	6.81	12.32	....
1934	12.0	17.1	68.0	79.1	61.3	79.8	10.67	26.12	....
1935	11.6	16.1	49.4	73.9	77.4	86.4	10.57	35.56	....
1936	11.7	17.2	99.6	85.3	76.7	96.0	8.93	31.78	....
1937	11.1	19.9	88.3	91.8	94.8	107.1	10.36	30.24	....
1938	8.3	17.2	55.5	76.9	49.0	66.1	7.55	21.13	....
1939	8.7	13.6	68.1	75.4	47.6	63.6	6.95	22.17	....
1940	9.6	15.1	70.7	85.2	59.0	73.9	7.62	24.31	....
1941	13.3	19.1	64.6	94.4	64.3	84.0	8.10	35.04	....
December	16.23	26.2	82.7	86.6	66.9	102.2	9.43	44.65	....
1942	18.51	28.3	110.0	108.3	79.5	101.8	10.05	44.42	....
January	16.93	25.4	97.6	93.0	72.7	106.1	10.15	43.24	....
February	17.80	15.0	104.5	98.6	76.6	104.9	10.76	45.04	....
March	18.06	13.4	103.9	100.2	78.4	105.1	11.03	44.18	....
April	19.03	12.7	116.2	102.4	79.7	99.7	11.13	43.90	....
May	19.17	21.3	114.8	105.6	81.4	99.8	10.82	43.99	....
June	18.26	30.2	111.1	108.6	81.9	95.7	10.00	43.87	....
July	18.55	31.0	125.8	112.2	83.1	94.6	9.05	43.20	....
August	18.03	33.5	115.4	137.3	83.4	95.4	8.89	44.04	....
September	18.59	35.1	107.7	120.5	82.6	102.6	9.03	45.33	....
October	18.87	42.3	102.5	107.9	77.5	103.5	9.39	46.46	....
November	19.22	39.8	108.4	103.5	75.9	104.4	9.84	45.01	....
December	19.55	40.0	111.8	110.3	80.2	110.3	10.46	44.72	....

Index Numbers (1910-14 = 100)

1920	259	166	358	201	223	255	178	240	....
1921	99	187	149	136	91	135	109	103	....
1922	152	219	139	120	90	117	98	162	....
1923	215	183	121	119	124	112	103	202	....
1924	223	183	125	156	141	126	111	177	150
1925	178	161	164	196	154	172	105	162	153
1926	122	172	267	178	108	154	109	126	143
1927	128	199	190	130	122	137	101	132	121
1928	150	192	119	128	138	129	89	175	159
1929	143	179	135	135	135	117	97	162	149
1930	100	124	179	132	120	92	95	122	140
1931	61	79	104	106	77	55	82	79	117
1932	47	101	62	65	43	44	63	45	102
1933	65	124	95	68	56	66	57	57	105
1934	97	164	98	90	95	91	89	121	104
1935	94	155	71	84	119	98	89	165	126
1936	94	165	143	97	118	109	75	147	113
1937	90	191	127	105	146	122	87	140	122
1938	67	165	80	88	76	75	63	98	101
1939	70	131	98	86	73	72	58	103	109
1940	78	145	102	97	91	84	64	126	121
1941	107	184	93	108	99	95	68	162	145
December	131	252	119	99	103	116	79	207	162
1942	149	272	158	124	123	116	84	206	199
January	137	244	140	106	112	121	85	200	204
February	144	144	150	113	118	119	90	209	161
March	146	129	149	114	121	119	92	205	136
April	153	122	167	117	123	113	93	203	158
May	155	205	165	121	126	113	91	204	152
June	147	290	160	124	126	109	84	203	169
July	150	298	181	128	128	108	76	200	200
August	145	322	166	157	129	108	74	204	256
September	150	338	155	138	127	117	76	210	191
October	152	407	147	123	120	118	79	215	226
November	155	383	156	118	117	119	82	208	238
December	158	385	161	126	124	125	88	207	293

Wholesale Prices of Ammoniates

	Nitrate of soda per unit N bulk	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11-12% ammonia, 15% bone phosphate, f.o.b. factory, bulk per unit N	Fish scrap, wet acidulated, 6% ammonia, 3% bone phosphate, f.o.b. factory, bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16-17% ammonia, Chicago, bulk, per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.05	$3.37	$3.52
1922	3.04	2.58	6.07	4.66	3.54	4.75	4.99
1923	3.02	2.90	6.19	4.83	4.25	4.59	5.16
1924	2.99	2.44	5.87	5.02	4.41	3.60	4.25
1925	3.11	2.47	5.41	5.34	4.71	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.15	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.35	4.32	5.70
1928	2.67	2.30	7.06	6.63	5.28	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.69	4.61	5.72
1930	2.47	1.81	4.78	4.96	4.15	3.79	4.58
1931	2.34	1.46	3.10	3.95	3.33	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.82	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.58	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.84	2.67	3.27
1935	1.47	1.15	4.59	3.10	2.65	3.06	3.65
1936	1.53	1.23	4.17	3.42	2.67	3.58	4.25
1937	1.63	1.32	4.91	4.66	3.65	4.04	4.30
1938	1.69	1.38	3.69	3.76	3.17	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.12	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.35	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.27	3.76	4.43
December	1.69	1.41	6.33	5.77	3.34	4.55	5.71
1942	1.74	1.41	6.11	5.77	3.34	5.04	6.76
January	1.69	1.41	6.96	5.77	3.34	4.71	6.30
February	1.73	1.41	6.98	5.77	3.34	5.23	6.62
March	1.75	1.41	6.48	5.77	3.34	5.46	6.93
April	1.75	1.41	6.48	5.77	3.34	5.46	6.80
May	1.75	1.41	6.29	5.77	3.34	5.46	6.97
June	1.75	1.41	5.23	5.77	3.34	4.98	6.94
July	1.75	1.41	5.99	5.77	3.34	4.86	6.80
August	1.75	1.42	5.77	5.77	3.34	4.86	6.94
September	1.75	1.42	5.69	5.77	3.34	4.86	6.97
October	1.75	1.42	5.72	5.77	3.34	4.86	6.80
November	1.75	1.42	6.06	5.77	3.34	4.86	6.53
December	1.75	1.42	5.68	5.77	3.34	4.86	6.53

Index Numbers (1910-14 = 100)

1922	113	90	173	132	117	140	142
1923	112	102	177	137	140	136	147
1924	111	86	168	142	145	107	121
1925	115	87	155	151	155	117	135
1926	113	84	126	140	136	129	139
1927	112	79	145	166	143	128	162
1928	100	81	202	188	173	146	170
1929	96	72	161	142	154	137	162
1930	92	64	137	141	136	112	130
1931	88	51	89	112	109	63	70
1932	71	36	62	62	60	36	39
1933	59	39	84	81	85	97	71
1934	59	42	127	89	93	79	93
1935	57	40	131	88	87	91	104
1936	59	43	119	97	89	106	121
1937	61	46	140	132	120	120	122
1938	63	48	105	106	104	93	100
1939	63	47	115	125	102	115	111
1940	63	48	133	124	110	99	96
1941	63	49	157	151	107	112	126
December	63	49	181	163	110	135	162
1942	65	49	175	163	110	150	192
January	63	49	199	163	110	140	179
February	65	49	199	163	110	155	188
March	65	49	185	163	110	162	197
April	65	49	185	163	110	162	193
May	65	49	180	163	110	162	198
June	65	49	149	163	110	148	197
July	65	49	171	163	110	144	193
August	65	50	165	163	110	144	197
September	65	50	163	163	110	144	198
October	65	50	163	163	110	144	193
November	65	50	173	163	110	144	186
December	65	50	162	163	110	144	186

Wholesale Prices of Phosphates and Potash**

	Superphosphate Baltimore, per unit	Florida land pebble, 68% f.o.b. mines bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports	Sulphate of potash magnesia, per ton c.i.f. Atlantic and Gulf ports	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[1]	Kainit, 20% bulk, per unit, c.i.f. Atlantic and Gulf ports[1]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657	$0.655
1922	.566	3.12	6.90	.632	.904	23.87	....	.508
1923	.550	3.08	7.50	.588	.836	23.32	....	.474
1924	.502	2.31	6.60	.582	.860	23.72	....	.472
1925	.600	2.44	6.16	.584	.860	23.72	....	.483
1926	.598	3.20	5.57	.596	.854	23.58	.537	.524
1927	.535	3.09	5.50	.646	.924	25.55	.586	.581
1928	.580	3.12	5.50	.669	.957	26.46	.607	.602
1929	.609	3.18	5.50	.672	.962	26.59	.610	.605
1930	.542	3.18	5.50	.681	.973	26.92	.618	.612
1931	.485	3.18	5.50	.681	.973	26.92	.618	.612
1932	.458	3.18	5.50	.681	.963	26.90	.618	.591
1933	.434	3.11	5.50	.662	.864	25.10	.601	.565
1934	.487	3.14	5.67	.486	.751	22.49	.483	.471
1935	.492	3.30	5.69	.415	.684	21.44	.444	.488
1936	.476	1.85	5.50	.464	.708	22.94	.505	.560
1937	.510	1.85	5.50	.508	.757	24.70	.556	.607
1938	.492	1.85	5.50	.523	.774	25.17	.572	.623
1939	.478	1.90	5.50	.521	.751	24.52	.570	.607
1940	.516	1.90	5.50	.517	.730	....	.573	....
1941	.547	1.94	5.64	.522	.748	25.55	.570	....
December	.594	2.00	6.00	.535	.755	26.00	.210	....
1942	.600	2.13	6.29	.522	.748	25.74	.205	....
January	.594	2.00	6.00	.535	.755	26.00	.210	....
February	.600	2.00	6.00	.535	.755	26.00	.210	....
March	.600	2.20	6.50	.535	.755	26.00	.210	....
April	.600	2.20	6.50	.535	.755	26.00	.210	....
May	.600	2.20	6.50	.535	.755	26.00	.210	....
June	.600	2.20	6.50	.471	.665	22.88	.185	....
July	.600	2.20	6.50	.503	.755	26.00	.197	....
August	.600	2.20	6.50	.503	.755	26.00	.197	....
September	.600	2.20	6.50	.503	.755	26.00	.197	....
October	.600	2.10	6.20	.535	.755	26.00	.210	....
November	.600	2.00	5.90	.535	.755	26.00	.210	....
December	.600	2.00	5.90	.535	.755	26.00	.210	....

Index Numbers (1910-14 = 100)

1922	106	87	141	89	95	99	....	78
1923	103	85	154	82	88	96	....	72
1924	94	64	135	82	90	98	....	72
1925	110	68	126	82	90	98	....	74
1926	112	88	114	83	90	98	82	80
1927	100	86	113	90	97	106	89	89
1928	108	86	113	94	100	109	92	92
1929	114	88	113	94	101	110	93	92
1930	101	88	113	95	102	111	94	93
1931	90	88	113	95	102	111	94	93
1932	85	88	113	95	101	111	94	90
1933	81	86	113	93	91	104	91	86
1934	91	87	116	68	79	93	74	72
1935	92	91	117	58	72	89	68	75
1936	89	51	113	65	74	95	77	85
1937	95	51	113	71	79	102	85	93
1938	92	51	113	73	81	104	87	95
1939	89	53	113	73	79	101	87	93
1940	96	53	113	72	77	....	87	....
1941	102	54	116	73	78	106	87	....
December	111	55	123	75	79	108	85	....
1942	112	59	129	73	78	106	84	....
January	111	55	123	75	79	108	85	....
February	112	55	123	75	79	108	85	....
March	112	61	133	75	79	108	85	....
April	112	61	133	75	79	108	85	....
May	112	61	133	75	79	108	85	....
June	112	61	133	66	70	95	81	....
July	112	61	133	70	79	108	83	....
August	112	61	133	70	79	108	83	....
September	112	61	133	70	79	108	83	....
October	112	58	127	75	79	108	85	....
November	112	55	121	75	79	108	85	....
December	112	55	121	75	79	108	85	....

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer materials‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash
1922.....	132	149	141	116	101	145	106	85
1923.....	142	152	147	114	107	144	103	79
1924.....	143	152	143	103	97	125	94	79
1925.....	156	157	151	112	100	131	109	80
1926.....	145	155	146	119	94	135	112	86
1927.....	139	153	139	116	89	150	100	94
1928.....	149	155	141	121	87	177	108	97
1929.....	146	153	139	114	79	146	114	97
1930.....	126	145	126	105	72	131	101	99
1931.....	87	124	107	83	62	83	90	99
1932.....	65	107	95	71	46	48	85	99
1933.....	70	109	96	70	45	71	81	95
1934.....	90	123	109	72	47	90	91	72
1935.....	108	125	117	70	45	97	92	63
1936.....	114	124	118	73	47	107	89	69
1937.....	121	130	126	81	50	129	95	75
1938.....	95	122	115	78	52	101	92	77
1939.....	93	121	112	79	51	119	89	77
1940.....	98	122	115	80	52	114	96	77
1941.....	122	130	127	86	56	130	102	76
December..	143	142	137	91	56	156	111	78
1942.....	157	152	144	92	57	161	112	76
January...	149	146	139	92	56	164	111	78
February..	145	147	141	94	57	173	112	78
March....	146	150	142	94	57	171	112	78
April.....	150	151	144	94	57	171	112	78
May.....	152	152	144	94	57	169	112	78
June.....	151	152	144	90	57	151	112	69
July.....	154	152	144	91	57	157	112	74
August....	163	153	145	91	57	155	112	74
September.	163	154	145	91	57	154	112	74
October...	169	155	145	92	57	154	112	78
November.	169	156	146	92	57	158	112	78
December..	178	156	...	92	57	154	112	78

* U. S. D. A. figures.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Beginning with June 1941, manure salts prices are F. O. B. mines, the only basis now quoted.

**** The annual average of potash prices is higher than the weighted average of prices actually paid beenuse since 1926 better than 90% of the potash used in agriculture has been contracted for during the discount period. From 1937 on, the maximum seasonal discount has been 12%.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizer

¶ Investigations on the influence of fertilizer placement on cotton growth are reported by H. P. Smith, M. H. Byrom, and H. F. Morris in Texas Agricultural Experiment Station Bulletin 616, entitled "Germination of Cottonseed as Affected by Soil Disturbance and Machine Placement of Fertilizer." In this work, a 4-12-4 commercial fertilizer at the rate of 500 lbs. per acre was used in all cases where an application was made. Observations on the effect of fertilizer placement on yield, root development, and germination of the seed, and also the influence of the mechanical stirring of the soil by the machine applying the fertilizer were studied. The fertilizer was placed in bands directly under the seed at different depths, and in bands on either one or both sides of the seed, again at varying depths. Best results were obtained when the fertilizer was placed in bands two inches to each side of the seed and one inch below the seed level. Applying the fertilizer in the same way but at greater depth below the seed level resulted in poorer germination. When the fertilizer was placed directly under the seed, just the opposite results were obtained; that is, the closer the fertilizer was to the seed, the poorer the germination. It is concluded, therefore, that fertilizer to the side of the seed, but not in contact with it, has a beneficial effect on germination. When all the fertilizer was placed on one side of the seed instead of on both sides, results were not quite so good although the difference was not very great. It was noticed that root development was affected by the placement of the fertilizer. When it was placed directly under the seed, the tap roots were not developed, apparently being limited by the layer of fertilizer. The band placement to one or both sides of the seed did not affect the tap root development, but it was noticed that fertilizer all on one side of the seed tended to result in greater root development on the side toward the fertilizer. Fertilizer significantly increased the yield of the cotton, and best yields correlated closely with the results on germination of seed and root development as mentioned above. The soil was stirred the same as would be the case if fertilizer were applied, but without actually making any application. Germination of the seed was not affected if the stirring was done similarly to that resulting from applying fertilizer in bands to the side of the seed. If the soil was stirred as would occur when applying fertilizer in bands under the seed, germination of the seed was reduced.

¶ Keen interest in the value and uses of plant hormones or plant growth substances still exists among amateur and professional plant growers; although, fortunately, the subject is no longer the craze of popular writers and Sunday supplement writers, as was the case several years ago. Those wanting carefully appraised and accurate information on the subject will welcome U. S. Department of Agriculture Miscellaneous Publication 495, "Plant-Growth Regulators," by J. W. Mitchell and R. R. Rice. Brief explanation as to the nature of plant growth substances, how to apply them, their use and value are

given by the authors. They then give a very comprehensive compilation of results obtained by investigators who have used various plant growth substances and reported their work on root producton by cuttings. The data are grouped by types of plants, giving the scientific name, horticultural name, time of year of application, material used, the concentration, duration of contact, and results produced. Appended is a list of 89 references.

"Fertilizers Used in Alabama, Season of 1942," U. S. D. A., Washington, D. C.

"Yield Data From Fertilizer Placement Experiments in Indiana for 1942," Agr. Exp. Sta., Purdue Univ., Lafayette, Ind., Agron. Mimeo. 36, December 1942.

"War-time Fertilizer Recommendations for Iowa," Dept. of Agron. & Hort., Iowa State College, Ames, Iowa, December 1942.

"Preparation and Use of Artificial Manures," Agr. Exp. Sta., Mass. State College, Amherst, Mass., Bul. 395, July 1942, Karol J. Kucinski.

"Inspection of Commercial Fertilizers and Agricultural Lime Products," Agr. Exp. Sta., Mass. State College, Amherst, Mass., Control Series Bul. 114, October 1942.

"Effect of Different Fertilizer Treatments on Earliness, Total Yields, and Percentage of Culls of Three Varieties of Tomatoes," N. Y. State Agr. Exp. Station, Geneva, N. Y., 1942, C. B. Sayre.

"Results of 1942 Fertilizer Experiments With Tomatoes," N. Y. State Agr. Exp. Sta., Geneva, N. Y., Charles B. Sayre.

"War-time Fertilizer Recommendations New York 1943," N. Y. State College of Agr., Ithaca, N. Y., Mimeo. 689, Nov. 20, 1942.

"Fertilizer Recommendations for New York State in 1943," Dept. of Agron., N. Y. State College of Agr., Ithaca, N. Y., Mimeo. 690, Nov. 20, 1942, E. L. Worthen.

"Field Experiments with Phosphate Fertilizers," Agr. Exp. Sta., R. I. State College, Kingston, R. I., Bul. 281, February 1942, T. E. Odland and T. R. Cox.

. ."War-time Fertilizer Recommendations for South Carolina," Clemson Agricultural College, Clemson, S. C., Cir. 224, Dec. 1942, H. A. Woodle and E. H. Rawl.

"Commercial Fertilizers in 1941-42," Agr. Exp. Sta., College Station, Texas, Bul. 619, September 1942, G. S. Fraps, T. L. Ogier, and S. E. Asbury.

"Some Effects of Nitrogen on Young Apple Trees," Agr. Exp. Sta., Burlington, Vt., Bul. 488, June 1942, B. F. Lutman.

"Truck Crop Investigations," Va. Truck Exp. Sta., Norfolk, Va., Bul. 107, April 1942, M. M. Parker.

"Truck Crop Investigations," Va. Truck Exp. Sta., Norfolk, Va., Bul. 108, July 1942, Harold T. Cook and T. J. Nugent.

Soils

"The Microbiological Oxidation of Ammonia in Desert Soils. I. Threshold pH Value for Nitratifixation," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., T. Bul. 96, Sept. 15, 1942, A. B. Caster, W. P. Martin, and T. F. Buehrer.

"Liming the Land," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Cir. 451, Sept. 1942, Firman E. Bear.

"Pertinent Research Data on Soil Conservation Practices," Soil Conservation Agr. Exp. Sta., Raleigh, N. C., Sp. Rpt., 1942, T. L. Copley, L. A. Forrest, and J. F. Lutz.

"Warren County North Carolina, Soil Survey," U. S. D. A., Washington, D. C., Series 1938, No. 2, July 1942, W. A. Davis, K. V. Goodman, A. J. Vessel, and W. J. Moran.

"Seneca County New York, Soil Survey," U. S. D. A., Washington, D. C., Series 1936, No. 14, April 1942, C. S. Pearson, R. B. Child, W. E. Kennedy, Warren Huff, and C. B. Lawrence.

"Chemical and Physical Properties of Some of the Important Alluvial Soils of the Mississippi Drainage Basin," U. S. D. A., Washington, D. C., T. Bul. 833, Oct. 1942, R. S. Holmes and W. E. Hearn.

"Morphology and Composition of Some Soils of the Miami Family and the Miami Catena," U. S. D. A., Washington, D. C., T. Bul. 834, Sept. 1942, Irvin C. Brown and James Thorp.

Crops

¶ "Sweet Potato Investigations in New Jersey," by V. A. Tiedjens and L. G. Schermerhorn, New Jersey Agricultural Experiment Station Bulletin 697, summarizes work that has been conducted by these investigators over recent years. The items are too numerous to review in detail here, but they cover observations on the variation in yield by individual plants, the influence of weather conditions, time of digging, and mulch on yield, and fertilizer investigations. The fertilizer investigations include work with starter solutions, fertilizer placement, time of side-dressing, and applying fertilizer in solution. Starter solutions were found to be advantageous, as was also the application of fertilizers in the form of a solution dur-

ing the growing season. Applying the fertilizer by means of bands to the side of the plant was beneficial in some years but not in others. It was shown, however, that the fertilizer should not come in direct contact with the roots of the plants when they are set out. The advantage of applying the fertilizer in the form of a solution appears to be related to weather conditions since when applied in this way dry weather does not seem to interfere so much with the utilization of the fertilizer. As a result of this work, the authors recommend three possible methods of fertilizing sweet potatoes. One of these is to use a starter solution when setting the plants, and to side-dress with 100 lbs. per. acre of 13-26-26 fertilizer dissolved in 200 gallons of water two weeks after setting out, and again 3 or 4 weeks later. Another method is to set the plants with a starter solution and side-dress with 400 lbs. of 3-12-15 fertilizer two weeks after setting and again five weeks later. The third method is to broadcast and plow-under 800 lbs. of 3-12-15 fertilizer, and use a starter solution when setting out the plants.

¶ The importance of proper fertilization of grass lands is shown by D. E. Dunklee and A. R. Midgley in Vermont Agricultural Experiment Station Bulletin 484, "Grass Land Maintenance in Vermont." Work conducted at several different locations so as to include a variety of soil conditions showed that nitrogen alone would not maintain a grass sod in good condition. As was to be expected, legumes died out quickly, and soon even the desirable grasses died out or were very unthrifty. With the use of a complete fertilizer such as 10-10-10, both the grass and legume stand improved and the sod apparently could be maintained in good condition for a number of years. It was found that botanical or vegetative composition of the sod depended more on the fertility level than on the seed planted. The authors state that trials carried on with 14 different seed mixtures showed that at the end of three years the sod was about the same in all plots. Spring application of the fertilizer was superior to fall applications. This is thought to be concerned primarily with the nitrogen component of the fertilizer rather than the phosphate or potash.

¶ Practical information on fruit growing in Texas is given by J. F. Rosborough and Cameron Siddall in Texas Agricultural Extension Bulletin B-73, "Orchard Management." It is stated that deep sandy loam soils, free of nematodes, should be selected, adapted varieties planted, provision made to maintain or improve soil fertility, and proper steps taken to control pests and diseases. In the fertilization of fruit trees, it is suggested that when the trees are set out, well-rotted manure be mixed with the soil when filling in around the roots. After the trees have started growing, fertilizer such as 6-12-6 or 6-9-3 at the rate of ¾ to a pound per tree the first year with 2 to 3 times as much in following years should be applied. Extra nitrogen can be given as needed. On sandy soils, where there is ample rainfall, 6-12-6 or 6-10-7 fertilizer should be used at the rate of 1 to 2 lbs. per inch of diameter of tree trunk. Cover crops should be grown so as to add organic matter and nitrogen to the soil and prevent erosion.

"Growing and Handling Cantaloupes and Other Melons," Agr. Exp. Sta., Berkeley, Calif., Cir. 352, July 1942, Glen N. Davis and Thomas W. Whitaker.

"Guide to Farm Practice in Saskatchewan," Dept. Agr., and Exp. Sta., Saskatchewan University, Saskatoon, Canada, 1942.

"Plant-Source Possibilities for Rubber Production in Colorado," Agr. Exp. Sta., Colorado State College, Fort Collins, Col., Press Bul. 96, Aug. 1942.

"Annual Lespedeza for Florida Pastures," Agr. Exp. Sta., Gainesville, Florida, Bul. 375, Sept. 1942, J. D. Warner and R. E. Blaser.

"The Chemical Composition of the Cotton Plant and the Uptake of Nutrients at Different Stages of Growth," Agr. Exp. Sta., Experiment, Ga., Bul. 222, Oct. 1942, L. C. Olson and R. P. Bledsoe.

"Onion Seed Production in Idaho," Agr. Exp. Sta., Univ. of Idaho, Moscow, Idaho, Bul. 247,

Aug. 1942, George W. Woodbury and Carl F. Dietz.

"Tomatoes by Direct Seeding," Agr. Ext. Serv., Lafayette, Ind., E. Bul. 281, Aug. 1942, Roscoe Fraser.

"Production of Hybrid Corn," Agr. Exp. Sta., Iowa State College, Ames, Iowa, Bul. P48, Sept. 1942, G. F. Sprague.

"The Atchison Experiment Orchard," Agr. Exp. Sta., Manhattan, Kansas, Bul. 301, May 1942, R. J. Barnett.

"Sorghums for Kansas," Agr. Exp. Sta., Manhattan, Kansas, Bul. 304, Sept. 1942, A. F. Swanson and H. H. Laude.

"Soybean Production in Kansas," Agr. Exp. Sta., Manhattan, Kansas, Bul. 306, Sept. 1942, J. W. Zahnley.

"Potatoes," Agr. Exp. Sta., Univ. of Maine, Orono, Me., Bul. 411-C, June 1942.

"Preparing Brush Land for Pastures," Agr. Exp. Sta., State College, Miss., Cir. 108, Sept. 1942, Ray H. Means.

"Seeding Permanent Pastures," Agr. Exp. Sta., Columbia, Mo., Cir. 244, Nov. 1942, E. Marion Brown.

"Value of Agricultural Research in Wartime," Agr. Exp. Sta., Bozeman, Mont., 48th and 49th Annual Reports, July 1, 1941-June 30, 1942.

"More Beef From the Same Number of Cattle on Nevada Ranches," Agr. Exp. Sta., Reno, Nevada, Bul. 162, Aug. 1942, C. A. Brennen and C. E. Fleming.

"Facts and Figures on Fruits and Vegetables," Dept. of Agr., Trenton, N. J., Cir. 336, June 1942.

"Distribution and Relative Importance of Various Fungi Associated With Pea Root-Rot in Commercial Pea-Growing Areas in New York," Age. Exp. Sta., Geneva, N. Y., T. Bul. 264, July 1942, O. A. Reinking.

"Four Steps in the Management of Farm Woods," Agr. Ext. Serv., State College N. C., Raleigh, N. C., E. Cir. 260, Aug. 1942, R. W. Graeber.

"54th Annual Report Rhode Island State College," Agr. Exp. Sta., Kingston, R. I., Contribution 614, June 1942.

"Regrassing Areas in South Dakota," Agr. Exp. Sta., S. D. State College, Brookings, S. D., Bul. 361, June 1942, C. J. Franzke and A. N. Hume.

"Potato Growing on the Cumberland Plateau," Agr. Exp. Sta., Knoxville, Tenn., Bul. 181, June 1942, J. J. Bird.

"Tennessee Beauty Strawberry," Agr. Exp. Sta., Univ. of Tenn., Knoxville, Tenn., Cir. 81, Oct. 1942, Louis A. Fister and Brooks D. Drain.

"Interrelation of Pollination, Position on Cluster and Set of Pears," Agr. Exp. Sta., Univ. of Vt. and State Agr. College, Burlington, Vt., Bul. 493, June 1942, E. W. Jenkins.

"Report on the Agricultural Experiment Stations, 1941," U. S. D. A., Washington, D. C., J. T. Jardine and H. L. Knight.

"Cooperative Tests of Sweetpotato Varieties, Introductions, and Seedlings for Starch Production and Market Purposes," U. S. D. A., Washington, D. C., Cir. 653, Sept. 1942, C. E. Steinbauer, L. L. Harter, George P. Hoffman, J. McD. McCown, R. M. Kingsbury, W. S. Anderson, and H. T. Cook.

Economics

¶ A study of the costs and practices of 25 tomato growers in Delaware is reported by K. W. Baker in Delaware Agricultural Extension Mimeo. Circular No. 15, "Tomato Cost and Management Study, Delaware—1941." These growers had an average yield of 363.6 baskets of ⅝ bushel per acre with an average profit of $30.17 for their work. Yields among the 25 growers varied considerably within a range of 152 to 723 baskets per acre. The net return also varied widely, ranging from a loss of $27.58 per acre to a profit of $128.89. The farmer with the lowest average yield operated at a loss on his tomato enterprise, although he did not have the greatest loss of all the farmers. The farmer with the highest average yield had the highest net profit. About half of the cooperators used lime while the other half did not. Those not using lime had a higher average yield and a higher average profit. This was contrary to the results obtained in a similar survey conducted in 1940. Starter solutions were used also by about half of the group. Those using starter solutions had an average yield of nearly 50 baskets per acre more than those not using the starter solutions, and they also had a higher net profit. Most of the growers conducted a test on the value of using extra potash applied as a top-dresser at the rate of 200 lbs. of muriate of potash per acre. This extra potash increased the yield on an average of 40 baskets per acre, and increased the net profit about $8.00 per acre. The fertilizer practices, other than in the potash test, varied considerably among the growers. The most popular fertilizer analyses were 3-8-10, 2-8-10, 4-8-12, and 5-8-12. Most of the growers applied some fertilizer broadcast before setting out the plants, although some applied

fertilizer only in the row at planting time. One grower did both. Most of the growers applied some type of side-dressing, which usually consisted of a complete fertilizer, although some used nitrogen alone or a nitrogen-potash top-dresser. All growers used manure, with the rate usually around 10 tons per acre. While these results cannot be applied too broadly since they include only 25 growers, the data are considered to be very significant and should enable tomato growers to obtain ideas on ways of improving their returns from this crop.

"Wanted—Man Power for Arizona Farms," Agr. Exp. Sta. Univ. of Ariz., Tucson, Ariz., Bul. 186, Nov. 1942, E. D. Tetreau.

"An Analysis of Farm Mortgage Experience in Kent County, Delaware," Agr. Exp. Sta., Newark, Del., Bul. 237, May 1942, M. M. Daugherty.

"Farm Tenure Law in Kansas," Agr. Exp. Sta., Manhattan, Kansas, Bul. 303, June 1942, H. Alfred Hockley and Harold Howe.

"Area Analysis and Agricultural Adjustments in Nemaha County, Kansas," Agr. Exp. Sta., Manhattan, Kansas, Bul. 305, Oct. 1942, W. H. Pine.

"The Stock-Share Lease," Agr. Exp. Sta., Manhattan, Kansas, Cir. 213, Sept. 1942, John H. McCoy and W. E. Grimes.

"The Place of Woodland in the Farm Organization in Coos County, New Hampshire," Agr. Exp. Sta., Durham, N. H., Bul. 337, June 1942, John M. Chandler.

"Satellite Acres," Agr. Exp. Sta., R. I. State College, Kingston, R. I., Bul. 282, 1942, W. R. Gordon.

The Salt That Nearly Lost A War

(*From page* 30)

weeds. But it was far from enough. At the end of the war everybody sighed with relief and went back to buying from Germany.

The Search for Buried Treasure

BUT that potash shortage had been near-tragic. A German scientist boasted that if the German armies could have held on two years more, lack of potash would have licked us. That was perhaps an exaggeration. But our soils were suffering. And a few people refused to forget. When Germany resumed her competition-crushing tactics, they insisted that safety for this country could lie only in discovering low-cost domestic supplies. Nobody knew where there were any such supplies, but they might exist. The actual discovery reads like romance.

Geologists had long been fascinated by the so-called Permian Basin, an irregularly shaped area covering thousands of square miles in Eastern New Mexico and Western Texas and Kansas. They said it once was an arm of the sea or a salt-water lake. Nothing above ground suggests buried treasure. But oil is here, and experts said potash ought to be. So private and public explorations concentrated on this area. Prospectors picked likely spots, drilled deep holes, and watched to see what came up. Potash came. An enormous ore body was outlined and accurately mapped long before human eyes went down to see what was there.

The first shaft was started in 1929. Production got under way in 1931. Three companies have gone into large-scale production, investing tens of millions in mines, refineries and equipment, and Carlsbad is now one of the world's great potash-producing centers. In 1941 the three companies produced 82 per cent of domestic output, the balance coming mostly from California. Day-and-night production and plant enlargements give promise that, barring unlikely bombs or unforeseeable acts of God, all the potash we'll need will continue to come up—a sweet contrast to World War I. And potash prices are actually lower now than in 1913. The cutting off of German shipments this time hasn't meant a thing.

Our soils are not starving, nor will they.

Experts draw the parallel between potash in the last war and rubber in this one. They call attention to the inspiring fact that in 1913 we produced 1 per cent of our potash needs, but in 1941 we produced 101 per cent. Literally, we have made ourselves invulnerable on potash. They say that we can, and must, do as well with rubber.

Plow-Sole Fertilizers Make Good Showing

(*From page* 18)

Here we see the early response of corn to the hill application of 3-12-12 at 75 lbs. per acre. In addition to this "in-the-hill" treatment, 700 lbs. of 10-10-10 were applied on the plow sole. Yields were increased from 79.4 to 96.0 bushels per acre.

those hybrid growers who grow corn after corn for several years on the same land without manure, will undoubtedly find this new method of applying high nitrogen mixtures a highly profitable investment; in fact, there are thousands of farmers in Wisconsin who may find it profitable to follow this practice even at ordinary prices for corn. The increase in yields of corn the first year may not be sufficient to completely pay for the entire treatment, but we know there will be substantial residual carry-over benefits to succeeding crops of small grains and legumes the second, third, and even the fourth year. When the total values of all increases are added together, I am confident that a good profit will be shown.

Several demonstrations were set up this past fall on fields which will be seeded to small grain and legumes this spring. It is reasonable to expect that where heavier applications of phosphate and potash are placed on the plow sole at a depth of from five to seven inches, the legume crops, particularly alfalfa and clover, will be able to secure adequate amounts of plant food for maximum growth the year following. This method of applying fertilizer is also being tried in Wisconsin on canning peas and will be tried on sugar beets, tobacco, potatoes, tomatoes, and other deep-feeding crops.

When the war is over and low-cost nitrogen becomes available in abundant quantities, we will be in position to

advise farmers concerning this plow-sole treatment for corn and other crops on quite a wide range of soils in Wisconsin. In the meantime, we expect to continue our demonstrational work and build up a fund of information and field-plot data from which we can draw more definite conclusions to use as a basis for recommendations to farmers when the war is over.

* 1942 Results—Fertilizer Demonstrations on Corn

Name & Address of Cooperator	Soil type	Treatment	How applied	Rate per acre in lbs.	Yield bu. per acre	Increase bu. per acre
Wm. Renk & Son Sun Prairie	Carrington silt loam	10–10–10 plus	Plow sole	700		
		3–12–12	In hill	125	83.7	16.2
		10–10–10	Plow sole	700	82.5	15.0
		10–10–10	Plow sole	1200	95.9	28.4
		3–12–12	In hill	125	77.4	9.9
		No fertilizer	....	...	67.5	....
Rufus Gillette Mazomanie	Sandy loam	10–10–10	Plow sole	700	68.6	27.1
		No fertilizer	....	...	41.5	....
Clarence Whitehouse Markesan	Miami silt loam	10–10–10 plus	Plow sole	700		
		3–12–12	In hill	75	96.0	20.6
		10–10–10	Plow sole	700	79.4	4.0
		No fertilizer	....	...	75.4	....
Harvey Lurvey Dousman	**Light sandy loam	10–10–10 plus	Plow sole	700		
		3–12–12	Drilled	100	72.2	18.6
		10–10–10	Plow sole	700	67.6	14.0
		3–12–12	Drilled	100	73.9	20.3
		No fertilizer	....	...	53.6	
Fred Schneeberger	Carrington silt loam	0–14–14 plus	Drilled in deep ahead of planter	450		
		3–18–9	In hill	75	97.5	33.3
		0–14–14	Drilled in deep ahead of planter	450	78.1	13.9
		3–18–9	In hill	75	78.1	13.9
		No fertilizer	....	...	64.2	....

* Two plots were harvested by farmers—no records available
** Part of the nitrogen in the 10-10-10 apparently leached out.

Quality in Grasses for Pasture and Hay

(*From page* 25)

approximately 160 pounds of phosphorus an acre were added. On the basis of two million pounds, 120 pounds of this were found in a very soluble form in the top three inches of soil. Only a relatively small amount of the phosphorus was found to have passed to the second three-inch layer of soil.

Available potassium was found to be about 200 pounds an acre on untreated soil, which is not a very large reserve. The use of muriate of potash had in four years increased the available potassium in the soil to 240 pounds an acre, which is a relatively small increase. There was no evidence of any consider-

able accumulation of available potassium below the top three-inch layer of soil. Apparently the grass had utilized a very large part of the applied potassium.

The analytical results indicate that there was a rather large utilization of the applied fertilizers by the bluegrass. It is apparent that only relatively small portions of the applied nitrogen, phosphorus, and potassium passed downward beyond the top three-inch layer of soil. There was small chance that any considerable portion of the plant food passed out of the feeding range of the grass roots. It is apparent also from these results that soluble fertilizers are utilized to a very high degree when added to a rather heavy bluegrass turf.

Crotalaria—A Crop That Grows Like Weeds

(*From page 9*)

total of 13.5 acres of tobacco where no crotalaria had been grown and sold it for an average of $334.28 an acre.

Crotalaria appears to be the best adapted soil-conserving legume around which effective rotations for the sandy land of the Coastal Plains may be built. Its ability to grow volunteer stands after the last cultivation of corn and following the harvest of the small grains particularly adapts it for use in soil-conserving rotations.

The foundation for sound rotations may be laid simply by planting either alternate rows, or every third row through corn, solidly to crotalaria. If it is planted at the same time as corn, it will produce a good crop of seed. By planting corn on the land again the following year and completing cultivation early, another crop of crotalaria seed will mature and shatter, thus insuring satisfactory volunteer stands.

Of all the crotalaria species, *Crotalaria spectabilis* and *Crotalaria striata* are grown most extensively. *C. striata* seems to be preferred in the Sandhill section of the Carolinas, whereas, *C. spectabilis* is grown almost exclusively in Georgia, Alabama, Mississippi, and Florida.

The latter is a more consistent seed producer in Florida and south Alabama than is *C. striata,* which is often attacked by an insect that tunnels through green pods and eats the immature seeds.

C. spectabilis is one of the most completely nematode-resistant plants grown in the South. This characteristic makes it of particular importance on cropland where nematodes do severe damage to lespedeza and other susceptible crops.

Crotalaria has grown vigorously on poor soils without fertilizers. The nitrogen supplied by the legume has been sufficient to make large increases in the yields of succeeding crops, particularly corn. As a result, there has been a tendency to grow corn and crotalaria several successive years on poor sandy soils without applying phosphate or potash.

Cases have been observed where ears of corn failed to fill out properly when corn was grown several successive years after crotalaria, without the application of fertilizer. There can be little doubt that on the poor soils where crotalaria is usually planted, applications of both phosphate and potash will be required to maintain crop yields, and to get consistently satisfactory growth of crotalaria. It is also possible that other elements such as zinc, copper, manganese, and boron may sometimes be needed on these poor soils.

Like other new crops that have been brought into the South, crotalaria has

had certain obstacles to overcome. One of these has been its possibilities as a poisonous plant. *C. spectabilis* is known to be toxic to livestock when eaten in considerable quantities. It is not a palatable plant and livestock eat very little of it when other kinds of forage are available. Many cases have been seen in Florida and Alabama where cattle were grazing in fields and pastures in which volunteer *C. spectabilis* was in full bloom, but no cases of poisoning were encountered. Animals seldom, if ever, eat enough of it to do them any harm so long as there is plenty of grass or any other palatable vegetation in a field or pasture.

J. M. Parker, a dairyman, near Tallahassee, Fla., has *C. spectabilis* all over his farm, including his permanent pasture. When asked about poisoning, Mr. Parker said he had not had any symptoms of it among his cows. He said the only animal he had lost recently was a cow that got into the field and ate too many green velvet beans. Mr. Parker said he had recently mowed a thick stand of crotalaria on a section of his pasture between his house and the road. The plants had reached such a height that they obstructed the view from the house to the road.

Further study of the conditions under which crotalaria poisoning occurs is needed. Farmers, like Mr. Parker, who have good pastures and who feed their livestock well do not seem to have difficulty with poisoning, even though their animals have access to crotalaria in all stages of its growth. Other farmers who pasture their fields very closely in the fall seem to have trouble. Apparently, animals eat little crotalaria unless they are practically starved to it. The crop is of sufficient value as a soil-conserving legume to justify studies to determine how it may be grown and utilized without endangering the lives of farm animals.

Crotalaria is making steady progress toward an established place in the agriculture of the Southern Coastal Plains, but it might make more rapid progress if given the benefit of a little more of the old Southern hospitality for which this section is traditionally famous.

Borax for Alfalfa in Tennessee

(*From page* 13)

farmers could produce alfalfa seed in "paying" quantities. There has been noted, in the three years prior to 1942, that where borax was applied the alfalfa bloomed more profusely; however, no attempt was made to determine the quantity of seed that might be produced. This year, there were 12 demonstrations selected from which seed was to be harvested on both untreated and treated portions of the field at the time of the second cutting. Unfortunately for this particular study, it began to rain unseasonally just before the time the alfalfa seed was ready for harvest and continued to rain almost daily throughout the State until the alfalfa seed which had set and matured had either germinated in the pod or had shattered. Observations, however, were that seed had set in "paying" quantities and that in a normal season it will be practical to attempt to harvest alfalfa seed on a limited acreage which has been treated with borax.

The story of the results obtained from the use of borax and potash can best be told by quoting from some of the demonstrators and county agricultural agents who cooperated with the demonstrators in making reports: For example, Assistant Agent Robert C. Smith of Coffee County reports on the R. L. Baker demonstration, which is typical

of six in that county, that "On this two-year old alfalfa the treated plots have much the best stand." Mr. Baker says that on the next alfalfa he sows he will apply both borax and potash when seeded. He states that several of his neighbors have used borax this fall on their alfalfa as a result of his demonstration.

Results Obtained From Use of Borax and Potash

Kenneth Parker, Assistant County Agent, Marion County, reports typically that on the demonstration of S. H. Blevins, "This field has an extremely poor stand except on treated plots; the field was pastured."

G. L. Cleland, County Agent, reporting on the demonstration of H. C. Jamieson, Williamson County, states typically that "Borax and borax-potash plots have 80 per cent stand, while check plot has not over 40 per cent stand." This demonstration is two years old and has not been retreated.

J. W. McClain, Assistant Agent for Sullivan County, in reporting the demonstration of J. E. Smith, states: "Stand is at least 200 per cent better where borax and potash were applied. The plots receiving the material were cut four times while the check plots were cut only three times. The plot receiving borax alone had insufficient treatment; potash is also necessary on this land."

J. A. Ewing, Assistant County Agent, Carter County, reporting on J. L. Persinger's demonstration, states: "Alfalfa had completely gone in check plots; this was a sick-loooking alfalfa field when materials were applied. Yields were doubled where treatment was made; see actual dry-weight yields per plot attached."

Other typical statements from demonstrators and agents across the State are: "Alfalfa on the treated portion grew off faster after each cutting"; "Must plow up my field next year—plots are the only alfalfa left"; "Crab grass has taken everything except the demonstration plots"; "I just bought enough borax to go on all my alfalfa."

It will be recalled, from a progress report made a year ago, that the potash-borax demonstrational work started in 1939 and 1940 when pilot test demonstrations were established in cooperation with the Tennessee Agricultural Experiment Station on fields of cooperative farmers who were having difficulty producing alfalfa successfully. The results obtained from these pilot test demonstrations indicated that the material had sufficient merit to continue the demonstrations on a broader scale. Accordingly, in 1941 test demonstrations were carried out in 21 Tennessee counties distributed throughout the State; in 1942, 23 counties were added to the list of demonstration counties to secure broader coverage and to include soil conditions not already covered. Usually five demonstrations were established in each county. In addition to this, 15 counties were added to the list to determine whether the use of borax would affect the yield of red clover. Altogether, there have been established approximately 300 demonstrations over the State.

Recommendations Based on Results

From the results of these demonstrations and reports which are being received from all over the State, borax will be recommended in 1943 throughout the State of Tennessee, with the possible exception of the Mississippi River Delta. Recommendations were made in 1942 with some reservations; however, alfalfa yellows were so prevalent early in 1942 that a general recommendation was made through the State, since a large percentage of the crop turned yellow during the early part of the season. Based on the demonstrations in 1940 and 1941, some of the county agricultural agents in the winter of 1941 and 1942 recommended borax applications on all alfalfa in their county.

Typical of such conditions were those in Sullivan County, where G. C. Baker,

Fig. 4. Fertilizer manufacturers and agronomists study effects of borax and potash on alfalfa in East Tennessee on a trip that began at the Mississippi River and ended at the foot of the Great Smokies.

County Agent, Bristol, reported that in the late winter and early spring of 1942 over 40 per cent of the acreage of alfalfa in that county was top-dressed with borax. Mr. Baker stated that in 1941 he called a county-wide meeting of his livestock producers and alfalfa growers to observe a certain demonstration just before the time of the second cutting. Mr. Baker and the farmers attending this demonstration decided then that borax was correcting the general trouble they were having, and a determination was made to recommend the practice generally in Sullivan County for 1942. County Agent Baker had the material stocked by dealers at two locations in the county and they assisted in the distribution of the material. It is thought that, based on the numerous demonstrations which are in more than half of the counties of the State of Tennessee and upon the publicity, field meetings, and tours which have been attended by farmers and fertilizer manufacturers during the past two years, at least 50 per cent of the entire alfalfa acreage in Tennessee will be top-dressed with borax before the 1943 season.

In June of this year there was arranged a State-wide tour which was attended by the major fertilizer manufacturers in Tennessee, as well as agronomists and other agricultural workers interested, to observe the effects of these demonstrations. It was concluded by the agronomists and manufacturers present that they would make fertilizer recommendations to consumers to include borax in their alfalfa treatment in line with the recommendations made by the Experiment Station and Extension Service, and arrange for their dealers, throughout the State, to stock the material and make it available to farmers for top-dressing and to those preparing to seed alfalfa. Many fertilizer manufacturers are considering making a special alfalfa grade of fertilizer carrying a certain percentage of borax. From the results found in Tennessee, recommendations on the use of borax generally in this State will be from 20 to 30 pounds per acre, applied as a top-dressing either at the time of seeding the alfalfa or any time during the dormant period of its growth, as from November 15 to March 15, or applied as a top-dressing immediately after any cutting.

The cyclone seed sower is fre-

quently used for applying this material as a top-dressing; and there were hundreds of instances where the material was applied after the first cutting in 1942 and, according to reports, controlled the yellows on the subsequent cuttings. It is not determined yet just how long an application of borax will last; possibly, for best results it should be applied every other year. The carry-over effect from an application may last longer; however, it might be economically practical to make more frequent applications. The carry-over effect from an application in 1941 is reported by D. B. Hendrix, County Agent, Sevier County, who states: "The carry-over from last year on the old alfalfa demonstration is the difference between good alfalfa and no alfalfa."

A study is being made by the Tennessee Experiment Station to determine the effect of borax when applied to alfalfa in varying amounts; repeated at intervals; applied to many other field crops, such as red clover, vetch, small grains; and survival of young seedlings when seeded in small grains. Extensive field demonstrations are being carried on by the Extension Service in cooperation with the Experiment Station to determine the practical effect of these applications when used by a practical farmer on a field scale. Therefore, the results from the work of this nature now underway will give us an answer, within the next year or two, as to the value of these materials when applied on other important crops produced in the State of Tennessee.

For Hershey Orchards Complete Fertilizer

(*From page* 16)

limestone at the rate of two tons per acre was applied in 1940.

This block of Yorks suffered moderately heavy winter-kill in 1935. Some die-back was noticed each year even as late as the summer of 1940. Quite a few trees had to be removed after most limbs were killed from the ground up. The lower branches usually died first.

As far as the other varieties of apples go, they seem to be responding quite similarly. I refer to Stayman, Grimes, Black Twig, Rome, and Delicious.

Previous to 1936 these orchards had been under other management. Much of the practice carried on earlier than that date was of the type which depleted the organic matter to the point where erosion caused serious loss on the more rolling sections. At quite a few of these points a cover crop would not take and even the weeds grew sparsely. It takes something more than commercial fertilizer to bring such spots around. These places got 500 pounds per acre of the complete fertilizer broadcast regardless of tree size. Their present condition of maintaining a satisfactory cover crop is credited rather to mulch hauled in. For material for the mulch we used what was most available—it happened to be weeds and stalks from a nearby potato field. Of course many of these weed seeds took hold the following year, but after all, we wanted something to grow and weeds in the orchard do not bother us so long as they make mowing machines. As the result most desired, the growth of a suitable cover crop, was attained by this one application, it has not been repeated. Since this experiment there remains with us a greater appreciation for the value of mulch where practicable.

On our peach blocks we have been using the same formulas, the rate of application differing according to the present fertility of the plots and the size and age of the trees. We have been more than pleased with our results to date. Terminal length has been fine and the thickness of these tips is better.

Leaves are of better color and certainly there are more of them. Last and also best, we feel certain that the quality of the fruit has been improved. We are on the complete fertilizer program and we expect to see a continuation of the splendid results already attained by following this program.

A badly gullied peach orchard in southern Pennsylvania. Lack of contour terraces and properly fertilized cover crops is responsible.

Boron Improves Canning Beets

(*From page* 22)

roots from areas which had received borax at the maximum rate had the highest boron content.

Iron. No significant differences occurred in the iron content of the beet tops. Borax treatments did, however, result in lower iron contents of the roots.

Ash. Borax treatments significantly reduced the ash content of the roots. The differences were highly significant for the treatments with and without borax, but no further decrease in ash content resulted from the greater rates of borax application.

The root symptoms observed in this experiment apparently were identical with those described by Raleigh and Raymond, and Powers and Bouquet. As previously stated, the affected areas were generally confined to a narrow zone near the periphery of the root, and the presence of surface cankers gave rise to a girdled condition. In contrast, the symptom described by Walker and coworkers was predominantly an internal blackening of the root. The latter type of symptom has also been reported by Cook and Millar.

There is no apparent explanation for the occurrence of the two fairly distinct types of symptoms. It has been proven conclusively, however, that both indicate an inadequate supply of available soil boron. Furthermore, the results of this experiment, together with the credible evidence contributed by previous investigators, show that these symptoms can be virtually eliminated by the application of borax. It is clear that

the amount of borax necessary to reduce the disorder to a minimum varies with the particular soil under treatment. Due to the injurious effects of an excessive amount of borax, it is obviously essential to limit the rate of application.

The results of other field experiments have shown occasional instances of moderate increases in the yield of beets from borax applications. The order of the increase obtained in this experiment, however, indicates that borax applications to certain soils may result in a great improvement in the yield of beets.

High sucrose content is probably an important factor in the palatability of canning beets. It is evident from the data that the roots of beets receiving inadequate boron contain less sucrose than those of normal beets. Analyses reported by White-Stevens (9) have shown this to be true.

White-Stevens has also reported that in the case of an inadequate supply of available boron, the leaves of beets contain more than the normal amount of sugar. Although the sugar content of the leaves was not determined in this study, it seems possible that the greater red coloration observed in the leaves of plants in areas not treated with borax may be an indication that these leaves contained a relatively large amount of sugar. The red pigmentation of beet leaves is due to the presence of anthocyanin pigments.

Many workers (3, 6), in studies of other plants, have found that the amount of anthocyanin depends primarily upon the amount of sugar present. Thus it appears that an accumulation of sugar in the beet leaves was probably the principal factor in the formation of excess anthocyanin. Furthermore, the presence of excess sugar in the leaves may be explained as due to a disruption in the process by which sugar is normally transferred to the root for storage. Haas and Klotz (2) found that boron starvation in citrus causes an impairment of the functional activity of the vascular tissue, which results in an accumulation of sugars in the leaves.

The abnormally high nitrogen content found in the roots of beets receiving inadequate boron is in agreement with data reported by several investigators. The reports show many instances of unusually high nitrogen contents of both leaves and roots of such plants. Two suggestions have been offered as possible explanations. The high nitrogen content may be due either to retarded plant growth or to the failure of the boron supply to regulate the intake of nitrogen.

It is evident from the data that the boron content of plants showing symptoms attributed to boron starvation is less than that of normal plants. It is important to note in this connection that, as the incidence of symptoms was reduced by borax treatments, the boron content of the leaves increased markedly, but the content of this element in the roots did not increase significantly. This seems to prove that the defects which occur in the roots are not caused simply by lack of boron in the affected tissue.

The abnormally high iron and total ash contents of plants receiving inadequate boron have been reported by several investigators. As in the case of the high nitrogen content, these may be due either to retarded plant growth or to the effect of boron on the intake of iron and other ash elements.

Summary

Canning beets were grown on an area of Thomas sandy loam in which sugar beets the previous year had shown symptoms of boron starvation. One treatment included only an application of 3-12-12 fertilizer; another consisted of this fertilizer together with a mixture of secondary fertilizer components other than boron. Other treatments included the 3-12-12 fertilizer and a mixture of secondary fertilizer components with borax supplied at rates of 10, 20, 40, and 80 pounds per acre. The results of this study may be summarized as follows:

1. It was found that beets growing in the areas not receiving borax showed root symptoms of boron starvation which differed from the characteristic internal black spots described by other workers. The root symptom observed in this experiment was predominantly a girdled condition of the surface due to the presence of relatively shallow surface cankers.

2. These symptoms were virtually eliminated by the application of borax broadcast at the rate of 80 pounds per acre. Lower rates of application were inadequate for this soil. Further improvements in the quality of the roots resulted from increased purity and sucrose content of the beets.

3. Borax treatments resulted in a marked improvement in the yield of beets.

4. As a result of borax applications, the boron content of the leaves increased very significantly, but the boron content of the roots did not increase significantly.

5. Boron starvation was accompanied by unusually high nitrogen, iron, and total ash contents of the root tissue.

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Our Renaissance

(*From page* 5)

it as the best historians of civilization see it—something broader and vaster.

It will be impractical for one to go into all the signs and phases of the fifteenth century Renaissance to filter it through, and so we may finish this essay under the decent limitations of allotted space. To me its connections and reflections upon the changes we are about to witness in world events are worth another chapter. Herein I will just lay down the opening principles of the striking resemblance one notes between that glamorous age of transition and the era we are living in today.

Historians of civilization tell us that prior to the Renaissance man passed through three perplexing and misty periods, at least in the time of the Middle Ages. Man gazed upwards for awhile into mysteries he could not fathom; then turned his terrified gaze downward to the fiery realms of the spiritual Hereafter; then, for a time he dwelt in bitter dilemma trying to find out why he was created and what hope lay ahead. Finally, with the new dawn of the Renaissance he entered upon the world of reality and reason, living with more confidence and less fright and delusion.

Reason on awakening began to penetrate everything; heaven and earth, water and light, the huge and great, and things infinitely small. Reason began to find out the relations of men among

themselves, the ways of nature, and the profound aspects of art and science. Ever since that first dawn of a new fund of reason, the history of the world has been merely an intensification of this searching and groping progress to ultimate goals of decency and sincerity and truth.

We should not feel discouraged at numerous set-backs and contradictions, the use of new power to destroy and to defame and demolish. These interruptions are probably superficial, when we know that after all there has been a great upward and onward curve of morality and honesty set going by man's use of reason.

OF COURSE, it's all mixed up, like any human element. The first Renaissance had its gross animal motives as well as its loftier and nobler aspirations. I quote a noted authority on that period, who says:

"First, we had the outlook of Philistine complacency, practical shrewdness, unpuzzled common sense, the view of the ruminant. The world was fair and green and full of sap, smelling delicious and tasting well. Drink as much of it as you can, for God, the patron of all ruminants, gave it to you for that purpose.

"Second, we know that the world is more than a tasty plot of grass; it is a place for building everything that is useful, beneficial, and serviceable; laboratories of physics, medicine, and chemistry; institutes and devices for the refinement and relief of existence. It is a field of operations inconceivably wide and inexhaustibly rich, for the realization of the full powers of reason. This is the heroic side as opposed to the animal side."

To me it seems that one good way to realize how much we are in the footsteps of the Renaissance would be to make a few simple comparisons of the conditions and situations, institutions and influences that led the men of the Middle Ages gradually into the Reformation and the Revival of Learning.

And then to put them side by side with some of the conditions we met only yesterday in our much shrunken world of the present—things leading us into the maelstrom of awful conflict, from which this Renaissance must surely emerge—unless the signs of the ancient zodiac fail us utterly.

I AM NOT trying to trespass on the field of pundits and savants who constantly address you in flowing prose through daily columns. Lacking some of their astuteness and breadth, to be sure, I merely wish to set down convictions held by a rather simple soul toward the age we are approaching blindfold.

Like some nauseous wave of bacterial fever, the years prior to the Renaissance were cursed with that scourge of all civilization, known as the Black Death. It crept unseen and unholy into hovels and mansions alike, finding no science fit to cope with its venom and its horrid finality. It was easier to count the survivors than those who had perished. You may compare the Black Death to the evils of World War Number One, not alone in bloodshed and misery during the strife, but in the bitterness, the gall and wormwood, the hideous political philosophies and sophistries which emerged like rats during the decade afterwards.

Then came the Flagellants, hordes of misguided monks who toured Europe whipping themselves, joined in time by bands of fanatics, lunatics, and criminals whose mission was to create frenzy and animosity and hysteria. In the midst of this revelry of blood lust, the Flagellants and their motley crew laid violent hands upon the Jews, making horrible pogroms of slaughter and revenge. Jews were driven into exile, their property seized, and all callings denied to them by the guilds.

Close after the Flagellants came the Beghards, or "free-thinking brethren" of the Rhine valleys. They were undisciplined groups of wandering miscreants, who lived largely by begging

and extortion. Whatever they declared to be "moral" was moral. Their idea was the omnipotence of the individual, and they taught selfishness and the worship of the Ego above all else.

Need one pause long before seeing a parallel here to the situation of Europe just a few years ago; to be sure, not quite as crude at first, but gradually assuming many of the aspects of those movements that presaged the Renaissance.

NOW take due note likewise of another parallel. The great revolution of social values during the Middle Ages just before the Renaissance was induced by the rise of the trade guilds. Organized originally to find better markets for its members and to provide care during illness and misfortune, this spirit of fellowship finally degenerated into a niggling guardianship and a rigid routine of rules and duties and observances.

No apprentice might go out for beer until a certain hour. No new work might be taken on until earlier orders were finished. Sizes of shops and numbers of employees were regulated to the letter. Only articles actually finished on the premises were allowed to be sold, so as to stop the rise of wholesalers. It had its better side, of course, wherein the traditions of the guilds worked for pride in craftsmanship, and labored long to produce a gem or a piece of cutlery or a wrought iron trinket. Today we have ushered in our stronghold of unionism, which also has its multitude of regulations and rules and tries to dominate the entire economic scene; lacking, unfortunately, some of the artistic sense of values which animated the ancient locksmith and potter, to leave behind them imperishable monuments of skill.

Then back there in the era before the Renaissance we see the rise of the town to replace the open country as the seat of culture and desirable living, of inspiration and hope. From this growth of the town culture sprang a wave of materialism and egotism, and made these settled centers breeding spots for all kinds of neuroses and lunatic-fringe movements. Men formerly lived in the country and became natural products of their open environment. When the medieval town originated, man found that things were just the opposite—man made his own environment, and huddled together for common comfort and defense. During the past twenty-five years agrarian power has likewise given way to bigger and busier and prouder towns, possibly robbing us of some perspectives and some physical stamina we sadly need to revitalize the world.

At least two final parallels remain. In the interval preceding the Renaissance, the public mind was much taken with mysticism, with omens, spells, and incantations, with the reading of planetary signs and belief in curses, witches, and demons. It is no trouble to find similar waves of superstition and belief in the occult and the spiritualistic among us in recent times. Indeed it was remarkable in frequency before the present conflict began.

AND lastly, on the eve of the Renaissance, youth was perplexed, dubious, skeptical, inclined to be critical of the past and cloudy about the future. Bodies of such disillusioned young men caused disturbances in public places and gave rise to numerous cults and demonstrations. This is only a too familiar accompaniment to the writhings and retchings of a world about to go berserk. It seems as though the uneasiness of youth leads to the recklessness of war.

Having tried to stutter forth a few opinions I have nursed along relative to the coming Renaissance, I will ask your tolerance once again, next month, to continue in this vein. There's a little yet to say which cannot be finished in one fling. Then we can buy our tickets and wait in confidence for the Train that I Never Took beyond Bender's Hill.

Gushing Hostess: "You know, I've heard a great deal about you."

Absent-minded Politician: "Possibly, but you can't prove a thing."

Young Miss Brown had just been prepared for the operation room and placed on the stretcher to be wheeled in finally by the nurses. While she was left alone one doctor approached, lifted the sheet, peeked under and left. Soon after another appeared, lifted the sheet, peeked under and left. Still another approached, lifted the sheet and peeked under. This was entirely too much, so she asked the man: "What am I here for, Doc, observation or operation?" He replied: "I don't know; I'm not the Doc; I'm the painter down the hall."

Wife: "Goodness, George, this is not our baby. This is the wrong carriage."

Hubby: "Shut up. This carriage has rubber tires on it."

Proud parent on meeting the new first grade teacher: "I am very happy to know you, Miss Smith. I am the father of the twins you are going to have next September."

The little old gray woman bent over the cherub in the cradle.

"O-o-o. You look so sweet, I could eat you."

Baby: "The hell you could, you haven't any teeth."

The next generation of youngsters is bound to be an improvement because they'll all be from registered fathers.

Impatient Customer: "Can't you wait on me? Two pounds of liver. I'm in a hurry."

Butcher: "Sorry, madam, but two or three are ahead of you. You surely don't want your liver out of order."

An exceedingly lively gent was astonished to read of his death in an obituary column. He called a friend.

"Did you see the paper? They printed my death notice in it."

"Yeah," said his friend. "I saw it. Where are you calling from?"

A tourist stopped in front of a little country store, dumbfounded at the sight of an enormous display of salt piled on the premises. Stack after stack, boxes, barrels and bags. Tons of salt, inside the store and out.

"Ye gods, man, you must sell a lot of salt!" exclaimed the tourist.

"No, I don't sell much," replied the storekeeper, "but you should have seen the guy that came here last week. He really COULD sell salt."

The emptier the pot the quicker it boils. So watch your temper.

A Natural Question

Guest (to host in new home): "Hello, old pal, how do you find it here?"

Host: "Walk right upstairs, and then two doors to the left."

AVAILABLE LITERATURE

The following literature on the use of fertilizers in profitable soil and crop management is available for distribution. We shall be glad to send these upon request and in reasonable amounts as long as our supply lasts.

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Greater Profits from Cotton
Tomatoes (General)
Asparagus (General)
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Sweet Potatoes (General)
Grow More Corn (South)
Fertilizing Small Fruits (Pacific Coast)
Potash Hungry Fruit Trees (Pacific Coast)
Fertilize Potatoes for Quality and Profits (Pacific Coast)
Better Corn (Midwest) and (Northeast)
The Cow and Her Pasture (Northeast) and (Canada)
Fertilize Pastures for Better Livestock (Pacific Coast)
What You Sow This Fall (Canada)
Home-grown Grains for Profitable Hogs (Canada)
What About Clover? (Canada)
Of Course I'm Interested (Pastures, Canada)

Reprints

B-8 Commercial Fertilizers in Grape Growing
K-8 Safeguard Fertility of Orchard Soils
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CC-8 How I Control Black-spot
II-8 Balanced Fertilizers Make Fine Oranges
MM-8 How to Fertilize Cotton in Georgia
A-9 Shallow Soil Orchards Respond to Potash
N-9 Problems of Feeding Cigarleaf Tobacco
T-9 Fertilizing Potatoes in New England
CC-9 Minor Element Fertilization of Horticultural Crops
DD-9 Some Fundamentals of Soil Management
KK-9 Florida Studies Celery Plant-food Needs
MM-9 Fertilizing Tomatoes in Virginia
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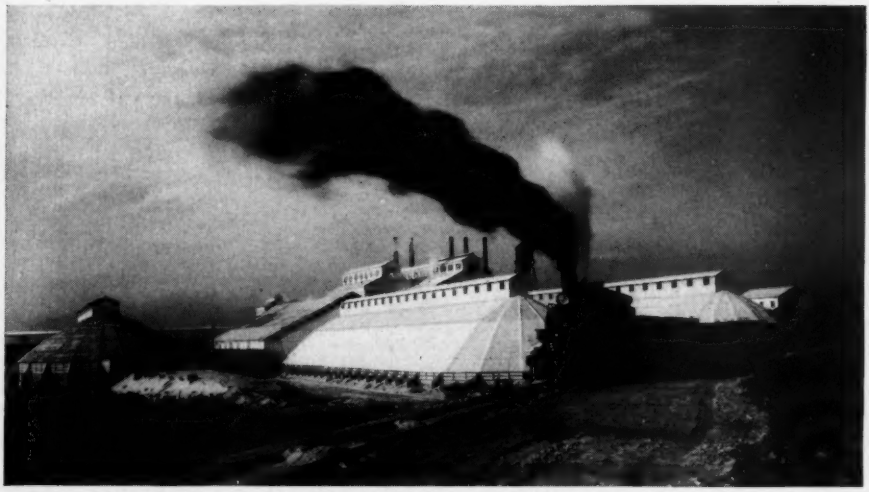

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